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SOIL STABILIZATION—

A SHORT COURSE

Based on Exhibit of U. S. Bureau of Public Roads Displayed at the Last Road Show

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PART III

ANY type of pavement or wearing course to be successful must be placed on a sound, stable subgrade, or it must have a base or foundation course thick enough and stable enough to transfer the loads, imposed by traffic, from the pavement or wearing course to the subgrade in a manner that will not overtax the supporting power of the subgrade in its weakest condition. Small increases in the moisture content often greatly reduce the supporting power of subgrade and base course material, especially certain types of subgrade clay and clay binder material. This has led to many failures in both low cost types and high types.

Fortunately, in some localities, the natural soils are so uniform in composition and provide such uniform support that they will satisfactorily carry pavements of the conventional theoretical design, and low cost surfaces, as well. However, in many sections of the country the roadbed soil in its natural state is either too unstable or too weak under certain climatic conditions to support the load. In such cases an adequate foundation must be provided either by stabilizing the natural soil through the use of natural materials, chemicals, or binders or by providing a foundation or base course or both. It is in such sections, which may be either on a state, county or city highway, that failures abound and where every effort should be exerted by the engineers responsible to improve the quality of engineering.

Stabilization engineering of roadbeds is primarily a study of local economics of road construction. In our study of soil stabilization as a whole, we must remember that the subject covers not only stabilization of the surface of the roadbed but also base course stabilization. The engineering analyses of soils for surface stabilization involve tests that produce information usable in design of embankments also, hence other installments of this series will discuss these determinations as they apply to embankment design, abutment backfills and foundation soils. It is now clearly seen that soil stabilization is one part of the general subject of soils mechanics.

Surface courses are those thin mats, placed on a base course, designed to withstand the abrasive action of traffic. Protective surface courses are more expensive than base courses, thickness for thickness. If the assumption is correct that a durable waterproofed thickness of soil will have the desirable load supporting properties required by the design standards we adopt we are forced to one conclusion—design the base so as to retain the water content at the percentage where cohesion is greatest and place thereon a relatively thin nonskid, renewable surface treatment.

Fig. 1.—Graded Mix Stabilized Soil Road, Without Admixture.

Four Types of Low-Cost Surfaces Which May Be Stabilized by Proportioning the Materials or by Treating with Admixtures

Type No. 1—*Graded Mix, For Light Traffic, Built With Best Local Materials Available.*—The main purpose of this type is to provide an inexpensive all-weather surface for light traffic on the land-service roads.* This surface may become dusty or muddy and portions may get rough or remain smooth. It may be built to serve all-year-round travel at costs up to $1,500 per mile. The surface requires continual maintenance.

The example cited in Part I of this Short Course, is an illustration of a soil mixture (herein referred to as Type No. 1) made from the best local materials available.

Type No. 2—*Graded Mix, For Medium Traffic, Built With a Designed and Proportioned Mix.*—This type provides adequate service for heavier traffic than Type No. 1 because the surface is wider and thicker, the mixture is designed carefully, and the various steps in the construction are controlled so as to produce a dense mix. This surface may be built for costs varying from $1,500 to $2,500 a mile.

The design of a soil mixture is based on (1) the grading of the combined coarse aggregate and soil mortar as determined by mechanical analyses, and (2) the binder properties of the fines as disclosed by the plasticity tests performed on the fraction of soil passing the No. 40 sieve.

Materials falling within the following gradations, by weights, should produce good results.

Passing	*Per Cent*
1-inch sieve	100
¼-inch sieve	85-100
No. 4 sieve	55-85
No. 10 sieve	40-65
No. 40 sieve	25-50
No. 270 sieve	10-25

Material larger than one-inch can be used under certain conditions but the amount should not exceed 10 per cent. The maximum size should never exceed ⅓ the thickness of the stabilized layer. The fraction passing the No. 270 sieve should be less than ⅔ of the fraction passing the No. 40 sieve.

Generally plasticity indexes of about 3 or less indicate sufficient binder cohesion for roads to be constructed on locations subject to unusually wet conditions; 4 to about 8, for conditions of average moisture; and 9 to 15 inclusive, only for the dryer or the arid conditions. Plasticity indexes exceeding 15 indicate soils not suitable for this type of construction.

The presence of the undesirable micaceous, diatomaceous, peaty or other organic substances is indicated by liquid limits greater than those indicated by the expression

$$LL = 1.6\ P\ I + 14.$$

The more the liquid limits exceed those values, the more unsatisfactory the soil binder is apt to be due to detrimental sponginess and capillarity. Elimination of such properties in detrimental amount from the final road mixture may be accomplished by keeping the liquid limits from exceeding about 35.

Base Courses.—All good stabilized surfaces do not make good bases because the plasticity index and liquid limit are generally *lower* for a base than for a surface. Except for those gradings shown within the overlapping bands on the chart, Fig. 2, good base soils are coarse and contain smaller amounts of silt and clay. Highly stabilized surfaces often become unstable when covered with impervious bituminous surface mats and used thus as bases. *Therefore, the design of a base course is different than that of a surface.*

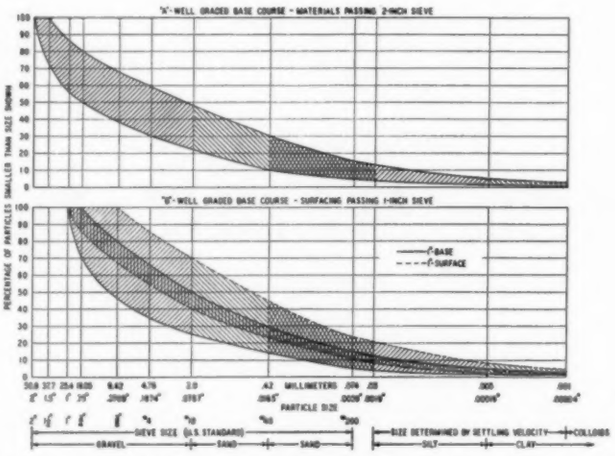


Fig. 2.—Particle-Size Accumulation Curves for Well-Graded Soil Mixtures.

Surfaces.—In the construction of surfaces, especially Type No. 1, more latitude may be used in the selection of materials than in the base courses for high type surfaces. The reason for this is that an error in the design may be corrected later by proper maintenance measures. In contrast, an error in the design of a base course means failure of the pavement laid thereon. A road surface, exposed to evaporation, requires more clay to hold sufficient film moisture to insure adhesion of the particles. On the other hand, evaporation from a base course is cut off by the impervious surface. *Therefore, the increased moisture in a good surface used as a base course causes all but the best of clays to swell and become unstable.*

Example of Determination of Mix.—In designing a proportioned mix it is desirable that limestone or slag screenings or pit run gravel be incorporated in the mix. Stabilized mixtures might be said to have three requirements, according to Mr. A. R. Smith, Engineer of Tests, Indiana State Highway Commission:

1. A well-graded, coarse aggregate. This may be pit run gravel, providing it is well-graded, crusher run limestone or slag, with a maximum size of 1½ in. or as desired.
2. A fine aggregate such as stone or slag dust, or sand, used to fill the large voids in the coarse stone, and containing sufficient material of minus 40 mesh size to give control of the plasticity of the finished mix.
3. A binder having a plasticity index of between 12 and 25. When using an aggregate deficient in lime-rock particles, a binder having a pH of less than 7 is not recommended. Acid soil binders can be used, however, if the mixture includes sufficient lime or limestone dust to neutralize the soil.

"A careful screen analysis should be made of each material proposed for use in the stabilization and the plasticity of each should be determined. Of the three constituents, the fine aggregate and the clay are interdependent. It is often the case that only one particular type or grading of fine aggregate or clay may be obtained. The other (of these two) must then be selected

*There should be included also under Type No. 1 all of those roads which must be kept in good serviceable condition for only certain seasons of the year for the purpose of accommodating tourist traffic.

so as to work satisfactorily with the constituent which is available.

"It is necessary that physical tests of the final mix show low capillarity, or water-absorbing properties, otherwise, the clay binder will act as a lubricant during wet periods. The soil fines of the finished mix (material smaller than 40 mesh) should have a liquid limit under 25, a plasticity index of 9 or less (for base courses, 6 or less) and a centrifuge moisture equivalent under 20, for average climatic conditions."

Of the several methods in use for establishing the proportions, the trial and error method is thought by some to be the most satisfactory. Indiana finds that the triangular-graph method gives very satisfactory results and eliminates the tedious process of assuming various values and actually mixing the constituents in these amounts, until the desired results are obtained. After the proportions have been calculated by the triangular-graph method, a single mix will usually check within desired limits.

In the use of this method all of the constituents are plotted on the graph according to the amounts of coarse aggregate, fine aggregate, and silt and clay they contain.

Mr. Smith continues as follows:

"By definition:

Coarse aggregate—All material retained on No. 10 sieve.
Fine aggregate—All material passing No. 10 sieve and retained on No. 270 sieve.
Silt and clay—All material passing No. 270 sieve.

"A mechanical analysis of a coarse aggregate, which in this case is crusher run limestone, gives the following gradation:

Sieve	*Per Cent Retained*
1-inch	2
¾-inch	24
½-inch	52
No. 4	73
No. 10	82
No. 40	90
No. 270	96

"The PI of the stone is 0; per cent of soil fines, 10; per cent of coarse aggregate, 82; per cent of fine aggregate, 14; per cent of silt (stone dust), 4.

"Mechanical analysis of the fine aggregate, agricultural limestone dust, showed the following gradation:

Sieve Size	*Cumulative Per Cent Passing*
No. 10	36
No. 40	72
No. 270	89

"The PI of the fines was 0; per cent of soil fines, 28; per cent of coarse aggregate, 36; per cent of fine aggregate, 53; per cent of silt (limestone dust), 11.

"Analysis of the soil binder, a silty clay having a pH value of 4.5 (after mixing with the aggregate the pH value was above 7), gave the following:

Sieve Size	*Per Cent Retained*
No. 10	1
No. 40	3
No. 270	15

"The PI of the binder soil was 13.3; per cent of soil fines, 97; per cent of coarse aggregate, 1; per cent of fine aggregate, 14; per cent of silt and clay, 85.

Computations.—"Plot the coarse aggregate (A), fine aggregate (B), and binder (C) on the triangular chart; draw the line AB. Any point on this line represents a combination of the two aggregates. In the same manner any point on a line joining the line AB and the point C represents a combination of C and of A and B in proportions determined by the point of intersection with the line AB.

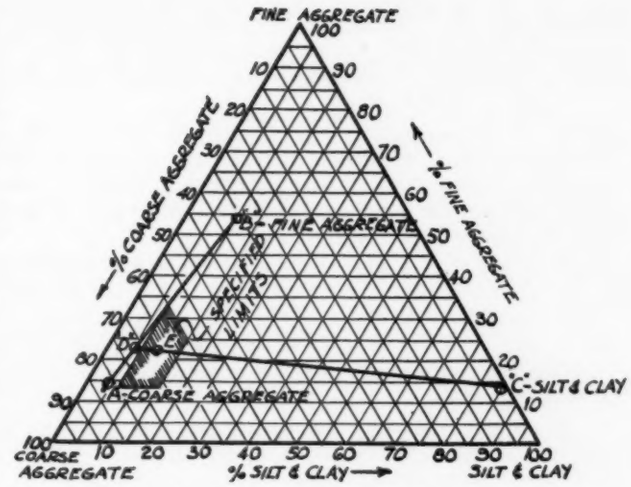


Fig. 3.—Triangular-Chart Method of Plotting Soils and Selection of Suitable Gradation.

"A good gradation for base construction using 1½ inch maximum size is given. For surfaces, the top size should be reduced to ¾ inch or as desired and the fines may be increased slightly.

Passing Sieve	*Limits Per Cent Retained*
1½ inch	0
1 inch	0-15
¾ inch	5-35
½ inch	20-70
No. 4	40-75
No. 10	60-80
No. 40	70-85
No. 270	85-93

"The gradation limits of the coarse aggregate, fine aggregate and silt and clay of the specification are plotted on the triangular chart.

Draw the line CD so that it falls well between the upper and lower limits of the specification band. Now that D is definitely located—

$$\frac{*DA}{AB} = \frac{2.09}{13.5} = 21.5$$ per cent of the per cent of fine aggregate in the combination of coarse and fine aggregate.

$$\frac{DB}{AB} = \frac{10.6}{13.5} = 78.5$$ per cent of coarse stone in this combination.

"Choosing the point E well within the specification band, the two segments DE and EC respectively represent the amounts of clay and the combined coarse and fine aggregate that make up the finished mix.

Thus: $\frac{DE}{DC} = \frac{1.45}{23.7} = 6.1$—the per cent of clay in

*Note: The segment DA representing the sand is taken farthest away from point B. The same is true of the other representative segments. The figures representing the length of the segments are measurements taken by any scale of an engineer's triangular scale. The proportions of the segments is what is desired so any scale will be satisfactory.

finished mix.

and: $\frac{EC}{DC} = \frac{22.25}{23.7} = 93.9$—the per cent of the combination of coarse and fine aggregate in the finished mix. To convert this to actual percentages of coarse and fine aggregate, it is necessary to multiply the fractions that go to make up the combination by the percentage of the combination in the finished mix.

Therefore: $93.9 \times 21.5 = 20.3$—the percentage of fine aggregate in the mix.

$93.9 \times 78.5 = 73.6$—the percentage of coarse aggregate in the mix.

"Thus the composition of the finished mix represented by the point E is:

20.3	per cent fine aggregate
73.6	per cent coarse aggregate
6.1	per cent clay
100.0	

"When the separate materials are combined in the above proportions, the grading of the mixture is as follows:

Sieve Size	*Stone Fraction*	*Fine Aggregate Fraction*	*Binder Fraction*	*Total % Retained*
1½	0=			0
1"	2 x .736=1			1
¾"	24 x .736=17.6			17.6
½"	52 x .736=38.2			38.2
No. 4	73 x .736=53.7	0 x .203=0		53.7
No. 10	82 x .736=60.4	36 x .203=7.2	1 x .061=0	67.6
No. 40	90 x .736=66.1	72 x .203=14.6	3 x .061=0	80.7
No. 270	96 x .736=70.6	89 x .203=18.1	15 x 0.61=1	89.7

Per cent passing the 270 sieve 10.3

"This mixture passes the grading specifications.

It is very desirable to check the plasticity index of the finished mix, in order that the material does not have detrimental water-absorbing properties. An approximation of the plasticity index of a stabilized mixture, composed of materials having widely different characteristics, can be computed by means of the following formula:

Let X=% of sample "A" in mix
Y=% of sample "B" in mix
Z=% of sample "C" in mix
S_1=% of Soil Fines in sample "A"
S_2=% of Soil Fines in sample "B"
S_3=% of Soil Fines in sample "C"
P_1=Plasticity Index of Soil Fines in Sample "A"
P_2=Plasticity Index of Soil Fines in Sample "B"
P_3=Plasticity Index of Soil Fines in Sample "C"
PI=Plasticity Index of Soil Fines in finished mix.

Then:

$$PI = \frac{(XS_1P_1) + (YS_2P_2) + (ZS_3P_3)}{(XS_1) + (YS_2) + (ZS_3)}$$

For calculating purposes, when P_1, P_2, or P_3 equals zero, the figure 3 is used in the formula.

"Substituting value and completing the calculation gives:

$$PI = \frac{(73.6\times10\times1)+(20.3\times28\times1)+(6.1\times97\times13.3)}{(73.6\times10)+(20.3\times28)+(6.1\times97)} = 4.9$$

A trial mixture must be made up in order to actually determine the liquid limit, the plastic limit, and from these the PI (Plasticity Index) of the resulting combined ingredients." The formula merely gives an idea of what may reasonably be expected.

Clay and Colloidal Fractions.—In these typical examples we have talked about the percentage passing the No. 270 sieve without stating exactly how to make the determination of this fraction, except as given on page 36 of the March issue in the fifth paragraph from the end of the page. The Pennsylvania State Highway Department has developed a standardized field method for checking the percentage of soil passing the No. 270 sieve using a metal hydrometer and calibrated metal tank. Hydrometer readings give results that can be interpreted by reference to Table I which they have set up.

Pennsylvania Procedure For Making a Soil Test Using Metal Hydrometer and 2⅜-in. Metal Cylinder.—Select the sample as it exists in the field and spread in a thin layer in order to dry it as quickly as possible. See Fig. 4. The amount taken need not exceed two pounds. After the sample is dry, sieve it over the No. 10 sieve, breaking down lumps of soil and soil adhering to stones, with fingers. A thorough sieving job is important. Quarter the material passing No. 10 sieve to the approximate amount required (about ⅓ pound).

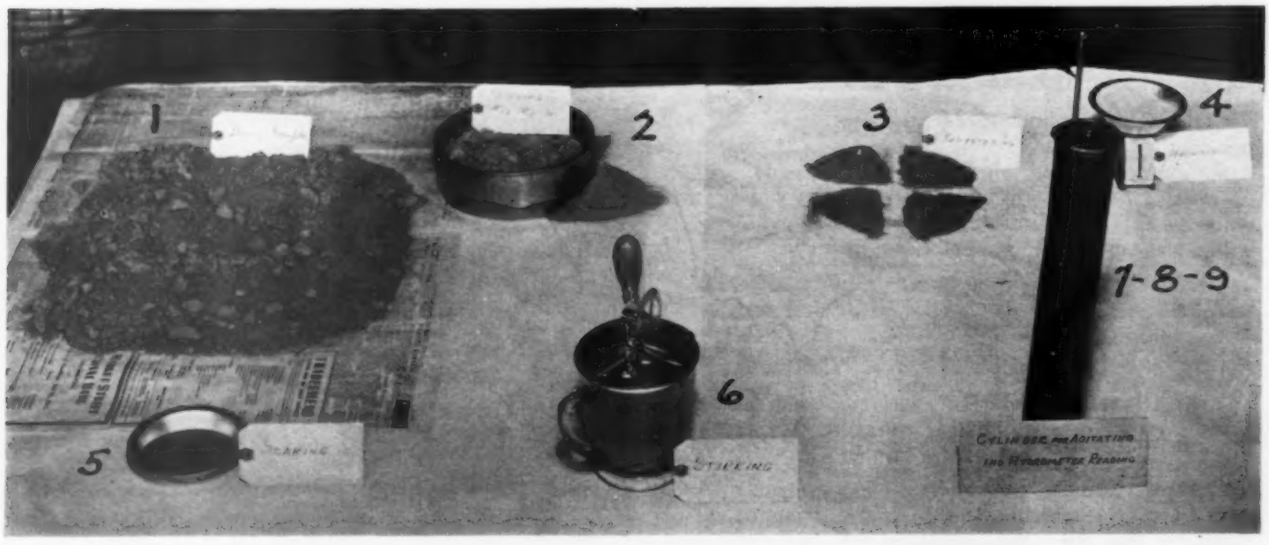


Fig. 4.—Equipment for Pennsylvania Metal Hydrometer Soil Test. The Mark on the Cylinder Represents 1,000 c.c.

Place weighing pan on scale, and be sure that the pointer reads over the upper mark scratched on the black field marked *P* (pan). Add the quartered material passing the No. 10 sieve, until the pointer reads over the lower mark scratched on the black field marked P + S (pan and soil). It is important to weigh as accurately as possible. Cover sample with water and allow it to soak for about 15 minutes.

Next, transfer the contents of the weighing pan to the stirring bowl and fill to the "3 cup" mark. Adjust stirrer and disperse the sample for at least 2 minutes. *It cannot be stirred too much.* Transfer contents of bowl to cylinder, rinsing bowl with more water and finally bring level in cylinder up to the mark.

Close mouth of cylinder with hand and rotate through 180° for one minute. At the end of this time quickly place cylinder on a level surface and mark time. At the expiration of 1½ minutes carefully lower the hydrometer into the center of the solution and at the end of two minutes from the time the cylinder is set in upright position take the reading and note same. Remove the hydrometer, dry it, and take a temperature reading of the solution.

Referring now to the hydrometer correction chart, locate the temperature in one of the brackets at the left under the column headed "Temperature of Mixture, °F." Follow this row to the right and located the hydrometer reading just taken. Follow this column vertically and read the top figure of the column headed "Per Cent of Soil Present Passing No. 270 Sieve"; this figure gives the percentage soil passing the No. 270 sieve which was present in the sample.

For example, suppose the hydrometer reading was found to be 29, and the temperature 83° F. Eighty-three degrees is located in the column at the left headed "Temperature of Mixture, °F," and in the bracket the third up from the bottom. Follow this row of figures to the right to 29, the hydrometer reading found. This figure is located in the solid block of figures headed "Hydrometer Reading." From this point read vertically upward to the figure 32, in the row of figures headed "Per cent of Soil Present Passing No. 270 Sieve." Thirty-two then is found to be the correct result after supplying the correction for temperature.

Transfer the contents of the cylinder back to the stirrer and repeat the test until the readings are constant.

Type No. 3—*Graded-Mix Base With a Bituminous Surface Treatment—For Heavier Traffic Than Type No. 2.*—This combination results in a smooth riding surface, with considerable resistance to skidding, which is free from mud or dust at all seasons of the year. This substantial surface treatment on a properly constructed base may be built for $3,500 to $5,000 a mile. When all new material is used the costs may exceed $5,000. Chemical admixtures may or may not be used in the graded mix. They are advantageous where climatic conditions permit their use.

Some highway engineers design all graded mixtures as base course with the expectation that as soon as funds become available bituminous seal coats and surfaces will be placed thereon.

Type No. 4—*Natural Soil Base Stabilized With an Admixture, and Having a Bituminous Mat Surface Treatment—For Heavier Traffic Than Type No. 2.*—A poorly graded soil may be stabilized with an admixture of bituminous materials or Portland cement. This surface when properly built is suitable for relatively heavy traffic. The meager data available indicate that this type may be built for prices varying from $4,500 to $7,000 a mile. If new aggregate is required to improve the grading of the fine grained material, the cost may exceed $7,000 a mile.

Types Nos. 1, 2, and 3 require *well graded* materials such as are indicated in Fig 2, within the typical grading bands shown on the charts. Well graded *surfacing* materials will fall within the *dashed* lines of the lower curves. The grading bands for good *base* materials are shown by *full* lines.

Quantities of Admixture and Binder.—From experimental and research work certain rates of application of chemical admixtures have been established. When calcium chloride is used, it has been determined that 0.5 lb. per sq. yd. per inch of thickness is required for best results. Not more than 2.0 lb. per sq. yd. should be

Hydrometer Correction Chart

Temp. of Mixture °F.	Per Cent Soil Present Passing #270 Sieve: 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Hydrometer Reading																									
35-45	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
45-55	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55-65	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
65-72	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
72-77	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
77-82	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
82-85	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
85-88	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
88-90	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Temp. of Mixture °F.	Per Cent Soil Present Passing #270 Sieve: 26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	Hydrometer Reading																								
35-45	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
45-55	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
55-65	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
65-72	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
72-77	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
77-82	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
82-85	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
85-88	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
88-90	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Temp. of Mixture °F.	Per Cent Soil Present Passing #270 Sieve: 51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	Hydrometer Reading																								
35-45	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
45-55	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
55-65	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
65-72	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
72-77	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
77-82	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
82-85	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
85-88	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
88-90	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70

Temp. of Mixture °F.	Per Cent Soil Present Passing #270 Sieve: 76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	Hydrometer Reading																								
35-45	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
45-55	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
55-65	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
65-72	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
72-77	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
77-82	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
82-85	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
85-88	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
88-90	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95

Table I.—Hydrometer Correction Chart for Determining Percentage of Samples Passing No. 270 Sieve.

applied, which limits the stabilized thickness to 4 inches. If greater thickness is required by the design, it is recommended that the extra depth, greater than four inches, be compacted without the chloride being incorporated.

There have been various amounts of sodium chloride (salt) used in stabilized work by the various states. The most common amount seems to be 2 lb. per sq. yd. for 3-in. depth. Indiana, in 1937, used 2½ lb. per sq. yd. throughout a 6-in. thickness.

These are the two principal admixtures, and they are incorporated only in fairly-well to good graded mixtures with the proper type of clay binder in the fines.

The bituminous, tars and asphalts, have been incorporated as binders in quantities varying from 3 to 8 per cent. An indication of a satisfactory amount to use can be obtained by employing the surface area method of determination. This is fully explained in "Low Cost Roads and Bridges" by Brown and Conner, pages 263, 264 and 265, first edition. Probably as good a method as any is by trial and test. Sample pats are made up and tested for stability, density, permeability, and shear. Binder quantities are varied and test results plotted from which the most desirable mix may be selected. The selected percentage of binder (usually 5 to 6 per cent, by weight) is converted into gallons per square yard and used as such. Construction methods vary somewhat, but the objective is greatest density, optimum water content, highest shear, and greatest stability. Usually, for base courses, the soil is just stained.

When Portland cement has been used as a binder, it has been mixed as thoroughly as possible with the crude equipment available, in rates varying from 4 to 9 per cent by weight of the soil. The cement content is usually based upon results of density and durability experiments on samples. Six to 7 per cent Portland cement binder, by weight, is the average content. As yet, no correlation between durability tests and actual field service has been made. Durability tests are useful in that they furnish a method of determining the comparative durability and stability of different raw soils and soil-cement mixtures and therefore, supply a logical method for determining the cement content required to meet field conditions.

Economics Involved.—Again it should be pointed out that the economics of the local situation will generally indicate the type of construction. Desirable graded mixtures will not be made if it is cheaper to use a binder of bituminous materials or Portland cement. Sometimes, it may be desirable, depending upon the funds available, the character of traffic on the road, the character of the soil, the climate and the availability of local materials, to build combinations of a well proportioned, graded soil mass and tar, asphalt or Portland cement binder for the base course.

For Stability and Long Life Use the Best Materials Available Within the Allowable Cost Per Mile of Road

Where clay in local soils is deficient in binding power, a number of admixtures may be used, such as: calcium, magnesium, or sodium chloride, the sulphite-liquor by-product of the wood-pulp industry, the "blackstrap" waste from molasses refineries, and the waste sizes from the manufacture of mineral aggregates.

Shrinkage and Swell.—The colloid fraction is the portion of the soil most susceptible to shrinkage and swell. In the properly graded sand-clay mixture, Fig. 5, the *colloid fraction* is only 6 *per cent* of the total soil volume but its *surface area* may be 146,000 *sq. ft.* per cu. ft. of the mixtures. The sand, silt and clay comprising 94 per cent of the mixture by volume, may have a surface area of only 33,000 sq. ft. per cu. ft. of the mixture. In other words, the *colloids,* representing only 6 *per cent* of the total volume, *are responsible* for 85 *per cent* of the *swell* of the sand-clay mixture.

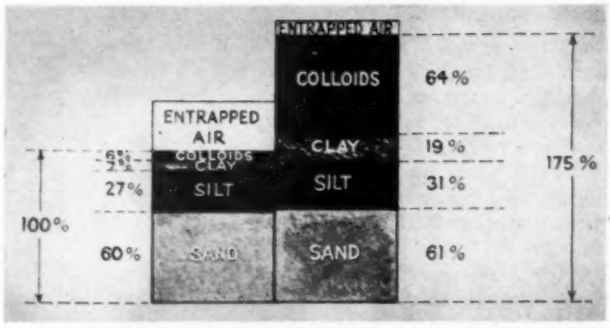


Fig. 5.—Comparative Swell of Property Graded Sand-Clay Mixture; Dry Sample on Left; Saturated Sample, 75% Swell on Right.

Natural gravels coated with Calcite, see Fig. 6, and other cements produce better results than similar materials without such coating.

Fig. 6.—Exemplifying Coated Gravel.

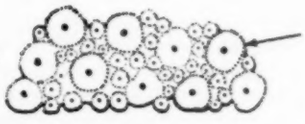


Fig. 7.—Exemplifying Colloidal Cements.

Iron and alumina clays, represented by Fig. 7 containing colloidal cements *may be used with greater tolerance,* especially in base courses, than the silica clays which have a greater affinity for water.

Waste aggregates such as limestones, slags, and other *soluble materials* in combination with water, develop a gelatinous surface coating which harden upon drying and produces a stable surface. Therefore, soluble materials possess a wider range of grading than insoluble materials as indicated in Fig. 8.

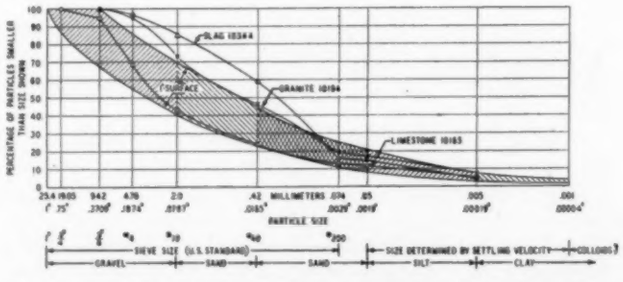


Fig. 8.—Particle-Size Accumulation Curves for Limestone, Slag, and Granite Screening Road Surfaces. Shaded Area Indicates Gradings of Good Surfacing Materials.

The slightly soluble limestone falling within the typical grading band at the left and the slightly soluble slag lying outside the band were sampled both from chemically-treated and satisfactory road surfaces. The insoluble granite, although chemically treated, was unsatisfactory until limestone screenings were added. *This demonstrates the fact that grading fails to produce a stable surface unless adequate binder is present.*

For best results materials of good quality must be

handled during the construction operations so as to insure proper mixing, compaction, and control of the moisture content; especially where Portland cement and bituminous binders are employed. Either road or plant mixing may produce graded mixtures such that the variation in the plasticity index of the finished surface shall not exceed 3.

Adequate compaction seems to be attained in chemically-treated mixtures with a moisture content of 8 to 12 per cent. Density of road surfaces increases under traffic construction. As applied to bases to be immediately surfaced, an effort should be made to reach a high degree of compaction during construction. Dry weight of 130 pounds per cubic foot of compacted materials would seem to be the minimum before application of the bituminous surface treatment.

In addition to the proper design and construction of graded mix roads, their maintenance immediately after construction is of utmost importance. With the best of materials, inadequate maintenance methods may cause unsatisfactory results. On the other hand, intelligent maintenance methods may be the means of correcting deficiencies in design and thus provide good results in cases where the original surfacing materials were not of the best quality.

Stabilization of Poorly Graded or Fine Grained Soils

The poorly-graded bases under Type No. 4 surfacing, described above, may be stabilized by asphaltic, tar, and Portland-cement binders. These binders serve a double purpose:

1. They prevent the clay fraction from absorbing water and thereby softening the soil mass.
2. They bind the soil particles together. Thus they produce a dense and stable, waterproofed slab, but *not a rigid slab.*

Fig. 9.—Capillary Water Is Sealed Out by the Binder.

Compaction tests are used to determine:

1. The proportions of the impregnating materials, and
2. The densities to which the slabs are to be compacted.

Fig. 10.—Spreading Cement That Has Been Dumped out Spotted in Place on Pulverized Soil.

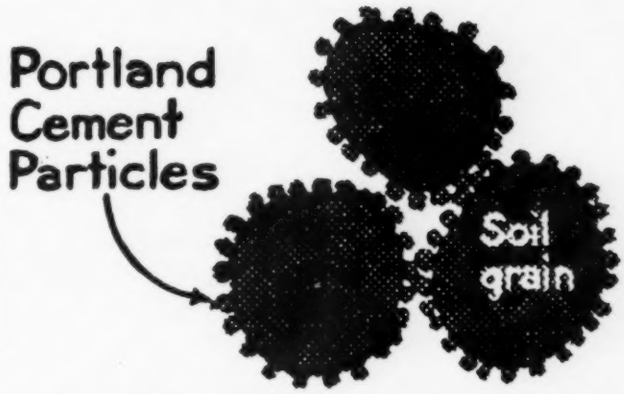


Fig. 11.—Showing Theoretically Desired Results Using Portland Cement.

Proper mixing is possible in the case of Portland cement when the materials are dry and powder-like so that when brought into close contact by mechanical manipulation the cement particles thoroughly coat the soil grains. This may be accomplished by road or plant mixing. The Portland Cement Association has set up specifications for this work in which road mixing is specified.

Next the pre-determined optimum amount of water is added and the mixture is made dense by compaction, after the water is worked in. Sheepsfoot, multiple wheel and similar types of rollers are used; but the predetermined density must be obtained.

Bituminous material, tar and asphalt, coats the soil more readily after the air films have been removed. A wetting or moistening of the soil before application of the bitumen prepares the soil particles for the binder. After mixing the binder the balance of the predetermined optimum water content is added and the mass compacted.

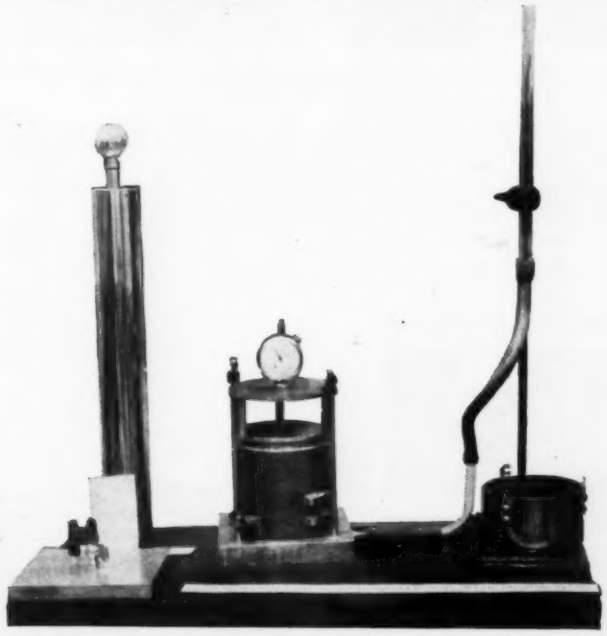


Fig. 12.—Compaction, Swell and Permeability Testing Equipment.

Soil Test Data Yield Structural Data

Soil test data yield like information when analyzed in accordance with the same engineering principles used for other structural materials such as concrete, wood and steel.

1. Stresses in earth masses must be determined by the design engineer.
2. Information as to the strength of the soil must be supplied by the testing engineer.
3. Strength data must be qualified by an appropriate factor of safety.

But—soil differs from other structural material in the following respects:

1. It has less strength.
2. Its deformations are enormously larger.
3. The factor of safety must be based on the allowable settlement or displacement of the structure instead of upon the ultimate strength of the soil, as is the case with structural materials.

Fig. 13.—Making a Compression Test With Terzaghi Testing Unit.

Foundation Design.—In the diagram, Fig. 14, the natural deposit of earth, resting upon a porous layer of sand on a solid rock foundation is old enough to have reached complete consolidation by its own weight. Any

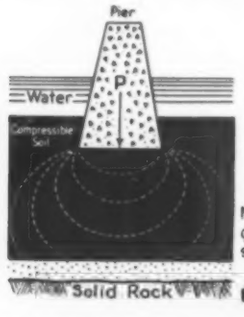


Fig. 14.—Soil Reaction Under Pier.

Fig. 15.—Possible Bridge Abutment Displacement.

pier placed in such a shallow foundation that it produces a greater pressure than the weight of the excavated earth causes the soil beneath to either, (a) consolidate vertically or, (b) displace laterally, the combined movement causing the pier to settle vertically. The distribution of the soil pressure under the pier, according to Boussinesq's theory, is represented graphically by the iso-pressure lines shown in Fig. 14. The effective pressure distribution is considered to be lineal from top to bottom.

In the design of the typical bridge abutment, Fig. 15,

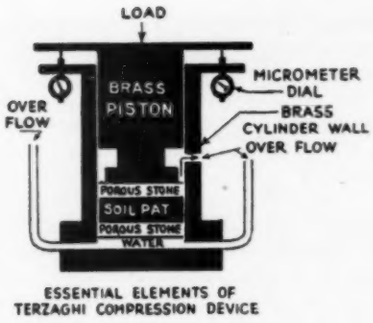


Fig. 16.—Terzaghi Compression Device Elements.

provision must be made to prevent excessive settlement as in the case of the pier and also to insure that the abutment will not be, (1) displaced laterally or, (2) rotated because of the subsoil slipping along some sliding plane as indicated in Fig. 15.

Terzaghi compression tests indicate the amount and rate of settlement caused by the consolidation of the saturated compressible foundation layer. The essentials of the device are shown in Fig. 16. According to the

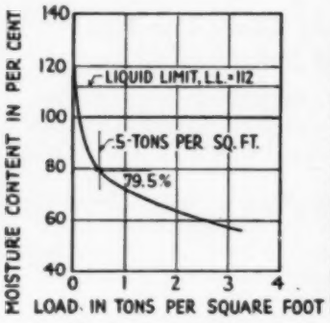


Fig. 17.—Pressure-Deformation Curve of Soil.

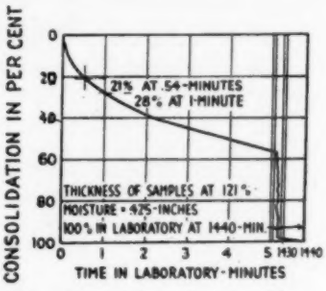


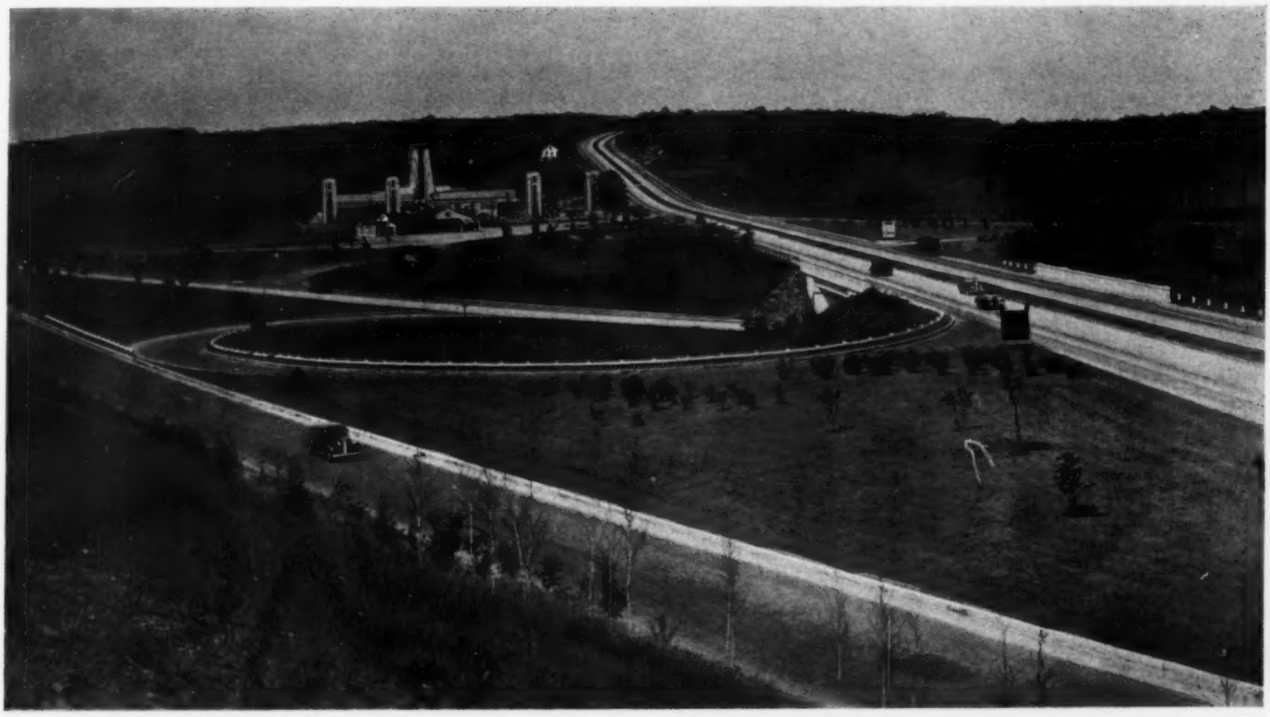
Fig. 18.—Time-Deformation Curve of Soil.

pressure-deformation curve, Fig. 17, a pressure of 0.5 tons will compress the sample to a moisture content of 79.5 per cent. According to the time-deformation curve, Fig. 18, 28 per cent of the consolidation will occur in one minute.

The periods of load application which produce equal percentages of compression in soil strata, sandwiched between two porous layers, and in their representative laboratory samples, *vary as the squares* of the thickness of the strata and the samples, respectively. A soil stratum free to drain from but *one* face requires *four times* as long to consolidate as a similar stratum free to drain from both faces, all other conditions being the same.

Roadside Development Progress

Roadside Development Sessions held at the recent annual meeting of the Highway Research Board are summarized in a special report just issued by the board. Advances in the technique and scope of highway landscape activities during 1937 are outlined, and the accomplishments of six sub-committees listed in abstract form. The latter include Erosion, Education and Public Relations, Zoning, Highway Types and Roadside Areas, Plant Materials, and Roadside Development Cost Records. Emphasis has been placed particularly upon the joint sessions held with the cooperation of the Departments of Design and Maintenance, covering discussions on erosion control, drainage, and wayside areas.



Cloverleaf at Junction of Routes 9 and 20, Northboro—June 15, 1937.

SUPERHIGHWAYS IN MASSACHUSETTS

By G. H. DELANO

Chief Engineer, State Department of Public Works, Boston, Mass.

I WILL outline what Massachusetts has done in building divided roadways, the lessons we have learned by experience and the resulting improved designs now being used and the further improvements in design we hope to make in the near future.

The first modern divided highway constructed by Massachusetts was the Boston to Worcester Turnpike, Route 9. The history of this road may be of interest, as it is typical of many Massachusetts roads.

The road was laid out and constructed in the early years of the nineteenth century as a privately owned toll road, primarily for stage coaches and freight wagons. It was laid out in as near a straight line as possible, almost without regard for topography. When the railroad was built, the completion quickly drove the turnpike company out of business and the road became a public way. From time to time parts were improved by local authorities but a large part remained a country lane, practically without traffic.

When State highways were first constructed in the latter part of the last and the early years of this century, it was considered necessary to connect up and pass through as many towns and cities as possible. The route from Boston to Worcester was therefore laid out in a roundabout way, passing through many towns and cities.

The Worcester Turnpike Divided Highway

Quite a few years ago it was evident that this road was obsolete and could never be made adequate and so plans and studies were made of the old turnpike as the most direct route between the two cities. As much as 15 years ago studies were made for a divided roadway on this location but funds were not available for a start until 1930.

The typical section was originally a 10 ft. grassplot in the center with vertical stone curbs, 8 in. face, two 20 ft. concrete roadways and outside these a 10 ft. parking lane on each side consisting of bituminous macadam and oiled gravel.

The roadways had a straight pitch down from the center plot curbs, so that all drainage disposal was at the outer edge.

It was soon found that a 10 ft. passing lane was inadequate as traffic tended to keep away from the curb and so on later sections the center plot was narrowed 8 ft. and a 1 ft. bituminous strip was inserted between the concrete and the curb.

The Newburyport Turnpike Divided Highway

The illustration of a section of the Newburyport Turnpike, Route 1, constructed in 1937 shows a number of changes in design from Worcester Turnpike. The photograph is taken from one of the highway grade separation bridges and the entering roads shown are the ramps leading to the cross road.

While the center plot is narrow in the foreground, approaching the bridge, wherever there is an opening it is at least 20 ft. wide. We found that the 10 ft. wide center plot should not be repeated. This width, at an opening,

View in Natick at Station 58 + 87 Looking West on Worcester Turnpike Before Construction—Jan. 19, 1932.

View at Same Station After Construction—Sept. 26, 1934.

gives a driver a false sense of security while he is making a left turn or U-turn. Even the small modern cars are about 16 ft. long and a car standing in an opening in a 10 ft. center plot is therefore overhanging into the high speed passing lanes, a most dangerous position. The center plot at openings should therefore be at least 20 ft. wide or else it should be so narrow that a driver making a turn will know that he is not safe waiting in the opening and will make the turn just as he would on an undivided road.

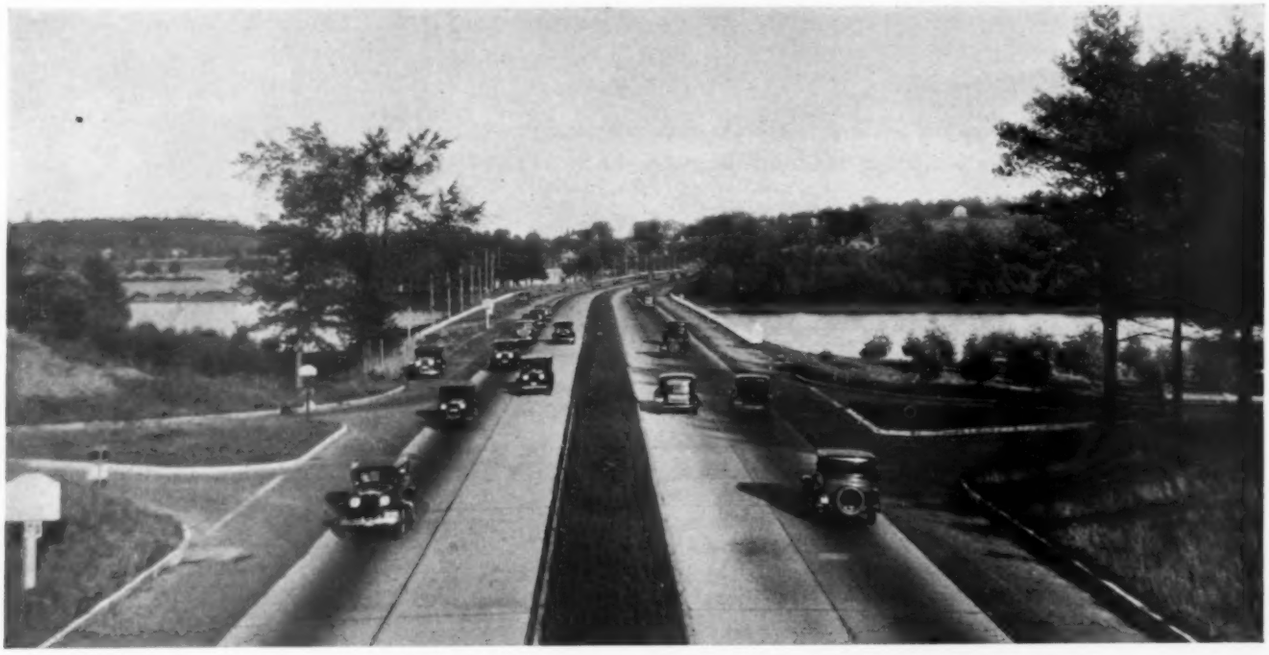
The curbs along the center plot are sloped, thus allowing more effective use of the passing lane and minimizing the danger of accident if the curb is struck a glancing blow.

These particular curbs are constructed on a 2 to 1 slope.

We have found that with this slope many drivers will cross the center plot wherever they wish, and to reduce this and still retain the sloped curb we are now using on our latest designs a 1 to 1 slope.

The passing lane next to the center plot is 12 ft. wide, the other traveled lanes are 11 ft. wide and the parking lane is 10 ft. wide.

Each roadway is crowned both ways from its center. This requires catchbasins along the center edges, but has the great advantage that snow plowed from the surface may be piled on the center plot with no danger of water from the melting snow crossing the surface and causing a hazard.



View Taken Sept. 15, 1933, in Southboro of Worcester Turnpike from Southboro Bridge—East.

Newburyport Turnpike in Saugus Dec. 21, 1937.

Newburyport Turnpike in Lynnfield—Dec. 21, 1937.

Another illustration shows a location on the same road where, because of a sidehill condition, the two roadways are at different grades.

The hard surfaced sidewalks, which are now a part of the construction of all Massachusetts State Highways except at localities remote from habitation, are shown in the illustration.

Highway Grade Separations

Highway grade separations are constructed at all important cross roads, where possible with a full cloverleaf design with four ramps. Our latest designs for superhighways go still farther and separate all roads except those of least importance. Those of small importance will cross without ramps or any physical connection to the superhighway.

All these designs to date are imperfect and extremely vulnerable in one particular; there is no restriction of the right of abutting property to indiscriminate access. Unfortunately the present Massachusetts laws do not permit such restriction.

Freeways

We have attempted to reduce the cause of accidents to which the road design contributes by the following features built into these superhighways: the center strip to eliminate head-on collisions and to reduce turning accidents, wider traffic lanes to reduce overtaking and passing and sideswiping accidents, parking lanes to reduce rear-end collisions, grade separations and other treatment of intersections to reduce intersection accidents, sidewalks to reduce pedestrian accidents and nonskid surfaces and proper disposal of surface water to reduce skidding accidents. Longer sight distances help in reducing nearly all types of accidents. On these roads we have established a minimum sight distance for safe stopping at 700 ft.

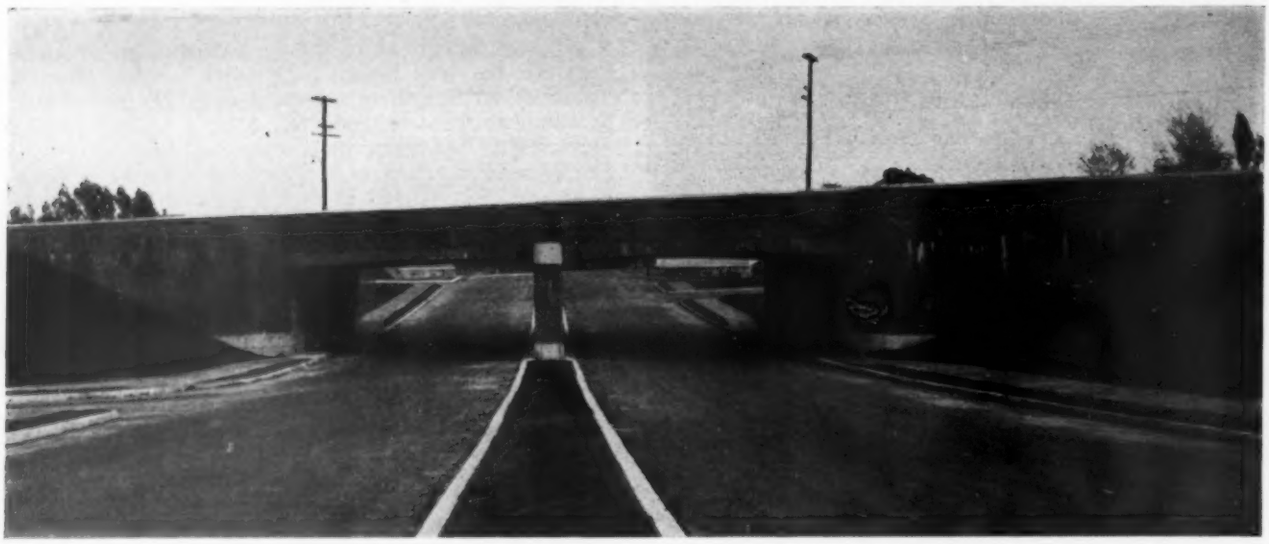
There remain two prolific sources of accident, neither of which can be avoided without the freeway design or something approaching it. These are accidents to pedestrians crossing the road and accidents to vehicles entering and leaving private driveways, particularly at gasoline stations and roadside stands, located without regard to the safety of the entrances and exits.

The cost of a freeway as compared with the cost of the more usual superhighway type we have been discussing is undoubtedly much more.

It seems out of the question to build a freeway following an existing road because of the rights of access already held by the abutting property although something approaching the freeway design may be secured by building the through highway in the center and a local service road on each side. This adds considerably to both the cost of construction and the cost of property damages.

In building on new location it is customary and proper in settling damages for the land taken to use as an offsetting factor the enhancement in value of the remaining land because of the construction of the road. If a freeway is built there is no such offsetting factor and, unless the location is such that the road follows property lines, the freeway will destroy all access to any public highway of much of the land through which it passes, unless parallel service roads or farm underpasses are constructed.

1936 *Bridge Construction on Newburyport Turnpike. Photograph Taken Dec. 22, 1937.*



1936 *Bridge Construction at Junction of Routes* 1 *and* 128 *Looking Northeast in Lynnfield. Photograph Taken Oct.* 18, 1937.

Despite this added cost I believe we are jeopardizing the investment we are making and will make in superhighways unless where possible they are laid out and constructed as freeways.

Since no freeways have yet been built in Massachusetts, I do not feel that I should attempt to discuss further the details of design or the difficulties that are sure to be encountered.

During this year we hope to secure the necessary legislation to permit the construction of freeways and to be able to start on our contemplated program.

Acknowledgment.—The foregoing is an abstract of a paper presented at the recent convention of the Association of Highway Officials of North Atlantic States.

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Stabilized Roads in Brown County, Wisconsin

By GEORGE J. CORMIER
County Highway Commissioner
Brown County, Wisconsin

The calcium chloride stabilized road might well and simply be defined as one made up of a graded combination of fine and coarse aggregates, cemented together with the proper amount of clay, which acts as a binding agent. We have always used the crushed materials, either stone or gravel, but it is possible to use pit run material, if preferred. If pit run material is used, the larger stones should be removed. There are several methods of construction which are being used successfully. We have always done our mixing right on the highway. We add our materials to the highway, our clay on top of our gravel or stone, and do our mixing with motor graders and a retread machine, with excellent results. The more mixing you do, the better road you have when completed. During mixing operations we do some sprinkling, to keep the aggregate moist and in this way obtain a better job.

After the mixing operations are completed, graders and retread machine lay out the material and shape the road to a crown of at least ½ in. to the foot. After we have applied water to the road surface, we place calcium chloride at the rate of 6 to 8 tons per mile, and then place more water on top of the calcium chloride. We find that, by adding this water, the calcium chloride dissolves faster, penetrates quickly, and traffic does the rest.

Some counties have had failures which may be attributed to the use of too much clay. At the American Road Builders' Association meeting at New Orleans, that point was stressed and it was recommended that less clay be used.

While you hear a lot about calcium chloride stabilized roads as bases for other kinds of surfacing materials, we have built and used our stabilized roads as wearing surfaces, with very good results. We have roads 5 to 6 years old that are in wonderful shape at the present time. Another thing we like about our calcium chloride stabilized roads is that, during icy weather, we have less ice to contend with on the stabilized sections than we have on our roads that have not been stabilized.

In the building of these calcium chloride roads, we also save a great deal on future maintenance. I would say 50 per cent to 60 per cent per year.

The town officials in Brown County are also sold on this low-cost road. We have one town, with a total road mileage of 20 miles, which has built to date 10 miles of this type of road. They intend to raise enough money, by asking for county aid, to finish the rest of their mileage this year. A little over 3 miles were built in this town last year and we decided to experiment and try something new. Using crushed stone as aggregate, we added clay as usual, and did the mixing with power motor graders and our Adams retread machine. During the mixing operations on about 1½ miles of the entire stretch laid, we added some water to moisten the aggregate and thoroughly mixed the materials with 2 tons of calcium chloride. Then we laid out the road and gave it the desired crown, placed another 6 tons of calcium chloride to the mile, and used water before and after the surface application of calcium chloride. This road was built in July, 1936, and, much to our surprise, we have not as yet graded the road in our maintenance season. Our experiment there has proved very successful and, in this year's program, we plan on doing our stabilized work in the same way.

Acknowledgment.—The foregoing is an abstract of a paper presented at the last annual convention of the American Road Builders Association.

J. I. Case Co.
Tractor-Mower Combination Cutting a Good Crop Beside a Macadam Road.

THE MAINTENANCE OF SHOULDERS AND RIGHTS-OF-WAY

A Review of Problems and Methods in Various States

Third and Last Installment

By JOHN C. BLACK
Field Editor, Roads and Streets

THE information here presented from Arizona, California, Iowa and North Carolina completes this series of maintenance articles. The preceding articles treated of conditions, methods and costs in Connecticut, Illinois, Michigan, Missouri, Nebraska, Washington and Wisconsin. Thus we have covered both sparsely and densely populated areas, as well as almost the entire range of climate and topography in this country. We are much indebted to the various state highway departments for their assistance.

California

The arid condition in California from about May 1 to October 15 makes the control of grass and weeds a somewhat different problem from what it is in localities where there is sufficient moisture to keep the vegetation growing during the summer season. For that reason, the shoulder area immediately adjacent the pavement for a width usually of 8 to 10 feet, particularly on turnpike sections, is kept free of all vegetation, and is maintained as an oiled or plain earth shoulder, depending on the volume of traffic and other conditions. The work of vegetation control between the shoulder points and the right-of-way line varies, depending upon whether the purpose is for fire prevention, control of noxious weeds, or for appearance alone. The method used varies, also, with the location, depending on soil and climatic conditions.

Mowing—Working Rates and Costs.—Where improvement of appearance is desired, mowing of roadside vegetation is preferred, as this treatment insures a neater appearance, reduces fire hazard, and protects against wind and storm erosion. This method does not necessarily eradicate obnoxious weeds, and in fact may tend to spread the growth unless carried out at the most favorable time. There are several types of mowers in use, but in general the work is done with a towing-type mower pulled by a light truck or tractor. From two to four swaths are usually required, depending on the varying widths and accessibility of the right-of-way. The outfit will average from 14 to 18 miles per day at an expenditure of $18.00 to $21.00. The average cost is $6.00 per

Firing Grass with a Distillate Spray, California State Highway.

road-mile for two swaths' width on each side for a single mowing. In certain locations favorable to the growth of vegetation it has been necessary to mow from three to seven times in a season.

Grading.—In certain areas the roadsides are graded for fire protection and weed eradication. This is a most effective method, as it destroys the plant growth, and if accomplished at the right time, effectively eradicates the weeds. The cost of grading is approximately the same per treatment as for mowing. The annual cost is less, however, as fewer treatments are required. As mentioned before, the chief objection to this method is that it loosens the roadside material and subjects it to wind storm erosion. The use of cultivators instead of graders would accomplish the same result at approximately the same cost. Cultivators are little used, however, as the Department is not equipped with such machines.

Oil Spray.—The third method is to spray the roadside vegetation with Diesel oil of 27+ gravity. This method was developed primarily to create a fire break between the roadside and the adjoining property. The ordinary practice is to spray a strip 9 ft. in width adjacent each fence line. Approximately 1/10-gallon of diesel oil is applied per square yard of surface treated. The average cost of this application is $20.00 per roadside mile. If the spray application is made when the vegetation is about 2 in. high, a very effective kill is secured, and practically no burning is required. If the vegetation is more advanced, however, burning must follow in about ten days to two weeks after the oil application. Burning costs average $10.00 per roadside mile, making the total cost of treatment about $60.00 per road mile. This method does not kill the roots or sterilize the soil. As stated, this work is for fire protection purposes only, and is not considered as adding to the appearance of the roadside. It is confined to areas alongside grain fields, pasture and timber lands.

Work Around Culverts, Guard Rails and Other Structures.—Vegetation close to culvert headwalls, guard rails and other structures is destroyed by Diesel oil or removed by hand methods.

Roadside appearance is farther improved by the cleaning of ditches, care of signs and other maintenance operations in addition to the regular programs above outlined.

A California Roadside After Being Sprayed with Diesel Oil and Burned.

A Right-of-Way on Which Weed Killer Has Been Used, Yolo County, California.

Arizona

In a general way, the weed problem in Arizona is limited to a few irrigated areas, though considerable blade work is done for the rebuilding of shoulders, backsloping of borrow pits and the like. Nearly all weed control work on shoulders consists of mowing, blading being used principally for reshaping. Cost of mowing

Cutting a Heavy Growth on a Steep Bank

Topeka Highway Mower Co.

both sides of the road, for an area varying between 20 ft. and 40 ft. is about $82 per year-mile. This covers from three to five mowings. High cost of mowing is incurred by irregularities in section, such as ditches, waste rock, variable widths of shoulder, etc. Once a constant section is established, these costs should be materially reduced.

Burning of 1 ft. by 2 ft. ditches is about $65 per year-mile. This provides for three burnings.

Iowa

Following is the full text of the Iowa State Highway Commission's Maintenance Instructions C-15, Revised June 9, 1937:

Roadside Vegetation

This letter supersedes and replaces Maintenance Instructions, C-15, dated June 12, 1934 (except Bulletin No. 37 and blue print of spray outfit).

Roadside vegetation falls into three classes:

1. Vegetation which is desirable and which should be preserved.
2. Vegetation which is not particularly harmful but which should be kept cut for the sake of the appearance of the road and in order to prevent snow drifting.
3. Vegetation which is classified by law as noxious and which should be destroyed.

Class 1 Vegetation

This class of vegetation which we wish to preserve includes native trees, shrubs, flowers and grasses.

Public sentiment for good looking roadsides is developing fast. We have recently constructed a number of roadside development projects and have made numerous plantings thereon. We should give careful attention to the maintenance not only of these constructed projects but all of our roadsides and preserve the natural beauties whenever possible.

Class 2 Vegetation

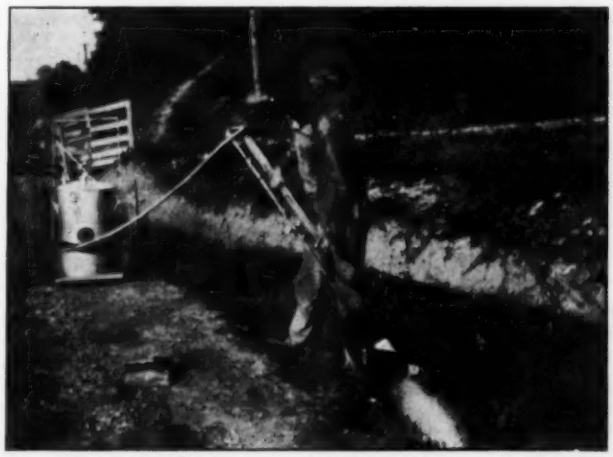
This class of vegetation is what we usually consider weeds although it includes rank growing grasses and clovers.

All vegetation on the shoulders of the road and part way down the inside slope of the ditches should be kept close cut. The number of cuttings will depend somewhat upon weather conditions but the cuttings should start in the spring and should continue until fall. Rye and other nurse crops which have been planted on the shoulders should be kept cut and not allowed to go to seed.

This class of vegetation from the ditch line to the right of way line should be cut once or twice during the summer. Low grading forage crops such as bluegrass, alfalfa, alsike and red clover may be cut by the owner of the land adjacent to the highway or by the person to whom we have issued a permit for planting such crop, at any time or as many times during the summer as they desire. The Highway Commission will not cut such crops unless they are mixed with weeds except that in the general fall clean-up any such vegetation which will cause snow drifts should be cut.

Sweet clover growing on heavy fill slopes may be left as a winter game refuge. Sweet clover occurring on any other portion of the right of way should be cut the same as other Class 2 vegetation.

Farmers should be encouraged to ask for permits to use the right of way particularly the wide borrow pits. for forage crops such as alfalfa, alsike or red clover.



Littleford Brothers Company.
Destroying Roadside Weeds with an Oil-Burning Torch

International Harvester Co.
A Tractor-Mounted Mower Working on a Back-Slope. The shoulder has already been mowed to the ditch line.

The use of the right of way for such crops is a beautification measure in itself and it also relieves us of the responsibility of mowing the roadsides.

Under no circumstances should the patrolmen be allowed to promiscuously burn off the highways. We have had numerous damage claims due to the fact that fires started by patrolmen have gotten out of their control. Numerous accidents have occurred due to the fact that smoke from roadside fires has obstructed the view on the highway. We will not say that no burning of rubbish is permissible on the highway right-of-way but such burning should certainly be reduced to an absolute minimum. Where it is necessary to burn heavy weed cuttings or brush in order to facilitate future cutting or to obviate snow drifting these materials should be carefully raked in piles and burned only under the strictest supervision of the Division Maintenance Engineer. No fires should be started by the patrolmen except with the full consent and knowledge of the Division Maintenance Engineer.

Class 3 Vegetation

The law (S. F. 148 47 G. A.) provides that primary noxious weeds along the primary roads must be destroyed by the Highway Commission. Noxious weeds listed in the law are Canada thistle, perennial sow thistle, quack grass, European morning glory or field bindweed, horse nettle, leafy spurge, perennial pepper grass and Russian knapweed.

You should retain this instruction Bulletin No. 37 issued by the State Department of Agriculture, also the blue print showing arrangement of air compressor and spray tank on a truck for use in spraying noxious weeds.

We carry a stock of weed killing chemical (Atlacide) in Ames. Atlacide should be mixed with water at the rate of 1½ pounds to 2 pounds per gallon and the noxious weeds should be thoroughly wet down with this solution. It takes about one pound of Atlacide per 100 square feet to make a good kill. The first treatment should be made when the plant is in blossom. This ordinarily is in June or July. In most cases a second treatment is necessary. This should be made in the fall when the plants approach their second blooming period.

All noxious weeds growing in any of our gravel pits should be destroyed just as promptly as those on the highway right-of-way and no gravel should be hauled from any pit which is infested with noxious weeds.

While the law does not specifically provide that we must destroy sour dock on the highway right-of-way we believe that where our rights-of-way are pretty well sodded over except for occasional sour dock you should destroy the weed. The eradication of this sour dock will improve the appearance of the highway and I am sure will be appreciated by the adjacent landowners. If the sour dock is cut off from 4 in. to 5 in. below the surface of the ground after a few seasons it will disappear or if the ground is soft it can be loosened with a spade and pulled. The latter, of course, is the most effective way of getting rid of it but the first method is ordinarily cheaper and quicker.

North Carolina

In North Carolina the maintenance forces mow shoulders with pull-type mowers, drawn by the Department's regular maintenance trucks (usually 1½-ton size). However, a pick-up truck is occasionally used for this purpose.

It is necessary to mow shoulders approximately three times each season. The cost for each mowing is approximately $3.50 per mile. This covers labor, equipment and fuel.

Hauck Manufacturing Co.
Burning Weeds Along a Gutter

THE "HOG" TAKES TO THE HIGHWAY

By DON MIGUEL STUART

THE motorist on midwestern highways today who sees a queer looking vehicle which causes him to wonder about having hallucinations needn't worry. Even though the vehicle has standard, pneumatic-tired wheels, but railroad drawbars, couplings, and air hoses—he still needn't worry. For it's the latest thing in rail-highway transportation—the Evans Auto-Railer.

Resembling a streamlined coupe, with "airflow" design, but with an over-grown size, the unusual creation may be driven on either a railroad track or a highway. That was why it was designed and built by the Evans Products Co. of Detroit, Mich. Noting that many short line railroads were having a difficult time in meeting operating expenses, and especially in earning net operating incomes, the Evans engineering staff decided to do something about it. What they did is represented in the Auto-Railer.

On a unit designed and built for the Chicago, Attica & Southern Railroad, Attica, Ind., the manufacturer used as the chassis a standard model SSU, FWD four-wheel drive truck. The motive power has so much "punch" that the railroad asserts it will move 300 tons of loaded freight cars in one train.

On the rails, the unit uses its four pneumatic-tired conventional truck wheels for driving power. The four-wheel-drive principle provides sufficient power for pulling either heavily loaded freight or passenger cars.

In front of the front axle, and behind the rear axle, are pairs of flanged railroad wheels which resemble the pilot wheels of a locomotive. They keep the vehicle on the railroad track. As the engineer approaches a grade crossing of a highway down which he wishes to drive his vehicle, he simply turns a lever which raises the railer wheels. Then, with the conventional truck steering wheel, he pilots the Auto-Railer from the track and roadbed, onto the highway, and drives away just as if he were operating a truck.

Re-railing is just as simple. The engineer approaches the grade crossing, or any road crossing of a track, drives onto the rails, turns his re-railing lever into position, and the unit is again a powerful locomotive for railroad service.

The chief advantage of the Auto-Railer, the manufacturer and the railroads which have used it assert, is that it may be used for pickup and delivery of freight consigned to towns off the railroad right-of-way, or for pickup and delivery in towns along the railroad. Thus, the Chicago, Attica & Southern line combines trucking operations with railway operations, and with a minimum of expense for motive power and rolling stock.

The Auto-Railer is built in three models: the locomotive itself, the pickup and delivery unit which closely resembles a small truck, and the passenger unit, which has the lines of a modern, streamlined bus. Passenger units seat about 40 passengers, and may be used as busses on the highways, or single-car units on railroad tracks. The "pickup" units may be used as railway inspection and maintenance of way cars, as well as light delivery trucks for highway service.

The locomotive unit has four-wheel, hydraulic, air-actuated brakes; five speeds forward and reverse; equal speeds in either direction; an all-steel body; a comfortable, roomy interior, seating seven men and operator; thirty-inch-wide sliding doors; safety glass throughout; a complete heating and ventilating system; grab handles and steps; foot boards at either end; and all necessary accessories for comfort, safety, and convenience of the engineer and passengers.

The Auto-Railer as a Locomotive

The chassis, according to the manufacturer, has a capacity of five tons (even though it hauls 300 tons of loaded freight cars); the wheelbase is 130 in. with pneumatic wheels as the gauge, or 184 in., figuring the flanged wheels. The engine is a six-cylinder, 462 cu. in. displacement, 125 h.p. unit, with a torque of 324 foot pounds at 1,000 rpms. Brakes may be used with air application for rail operation. Couplers, A. A. R. fully automatic, front and rear; the body is all-steel, with shatterproof glass doors on each side. The body is 90 in. wide, and 67 in. high, inside.

The Chicago, Attica & Southern railroad, which uses three of the units, operates 135 miles of main line, running north and south, in Indiana, between West Melcher and Wellsboro. Truck line connections, every 15 miles, make it an important feeder line for Class I carriers. A 21-mile branch between Percy Junction and State Line Junction gives the railroad a total of 156 miles of operated trackage.

▼

Shall—Will—May

One may have wondered, if any thought at all was given to the subject, at the use of the words, "shall," "will," and "may" in specification writing.

The word "shall" should be used in specifications where they are binding on parties of the first and second part.

The word "will" should be used wherever the specifications are intended merely to express a declaration of purpose.

The word "may" should be used wherever the specifications provide definitely for alternative courses.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ Sometimes erosion control runs into a big expense as indicated by this paved backslope. At that, it's about

the cheapest way out considering the lay of the land and type of soil.

• •

¶ Charlie Murray tells the story about a bridge engineer years ago who was confident of his work. He knew his bridges. During a gab-fest one day the boys were kidding him and asked him if he could build a bridge across the Delaware River. He said he could. Then, could he build one across some big body of water; he said he could. Next the attorney in the crowd asked him if he could build a bridge from here to Heaven. He said, yes, if the attorney would build the abutment there first.

• •

¶ On another grading job that Charlie went to write up, he arrived in camp just at the time the bull-cook was banging the triangle for dinner. All the gang tore at top speed from the bunk shacks toward the mess hall. One unfortunate skinner got his toe caught in a tree root and fell flat on his face. He laid there. Charlie went over to see if he was hurt. When asked why he never got up, the skinner said, "No use now, the chow's all gone."

¶ Another thing I don't understand is why there is not more complete uniformity of traffic control when signal lights are used; i.e., uniformity amongst our many cities and towns. In some places one may turn right on a red light and if it were done in another town a policeman's ticket would result. In some towns left turns are permitted on red lights, after the flow of cross traffic has passed, whereas in other towns left turns can be made only on green, if at all. In other towns, if a left turn is to be made, one moves on his green light over to the right in the middle of the street and stops crosswise to the traffic on the cross street, like in Cleveland, Ohio. It's a big gamble for a stranger.

• •

¶ Speaking of unsafe highways or danger spots; what do you think of this spot in Ohio? My warning to you is—drive cautiously as you approach if you are enjoying this life.

Not a Beauty Spot in Ohio—Just a Danger Spot

¶ I noticed this tandem operation of big wheel scrapers. It's the first time

I'd seen tandem operation on such big units. The job is in California.

• •

¶ Grading camps and grading contractors, in the old days, were a breed of cats distinct from all else. Contractors used to bid off large yardages and sublet in smaller amounts to their friends. One contractor, Charlie Murray says (and these he claims to be actual happenings), offered 200,000 yds. at 26 cents to one of his friends. The sub said he could not take it at that price. When asked why, his answer was, "I'll take it for 25 cents. I know that when I get four yards I've earned a dollar. You can't divide a dollar by 26."

• •

¶ Another of Charlie's reminiscences has to do with a grading job he was on one day. The blacksmith had just finished fashioning an S-iron. He threw it on the ground to cool. Next he finished a mule shoe and threw it down beside the S-iron. A skinner came dashing up to get his mule and stumbled, lighting seated on the hot irons, which branded a U S on his anatomy such that sitting was a painful pastime. Later the skinner joined the army and the medical officer wanted to know how he got loose.

¶ A contractor in Illinois, when pressed for money he still owed to an equipment dealer, sent the following letter:

"My dear sir:

In reply to your request to send a check, I wish to Inform you that the present condition of my bank account makes it almost impossible. My shattered financial condition is due to Federal laws, State laws, County laws, City laws, Corporation laws, liquor laws, mother-in-laws, brother-in-laws, father-in-laws, and outlaws.

Through these laws i am compelled to pay a business tax, amusement tax, head tax, school tax, gas tax, light tax, water tax, sales tax, potato tax, processing tax, social security tax, auto tax, liquor tax, and destructive tax. Even my brains are taxed. I am required to get a business license, car license, truck license, not to mention a marriage license, dog license, hunter's license, and fishing license.

For my safety I am required to carry life insurance, property insurance, business insurance, earthquake insurance, workmen's insurance, compensation insurance, unemployment insurance, accident insurance, automobile insurance, and fire insurance.

I can tell you honestly that except for a miracle that happened I could not enclose this check. That wolf that comes to many doors these days came to mine and just had pups in my kitchen. I sold them and here is the money.

Faithfully yours,

JOHN DOE."

• •

3/21/38

———— St.,
C————n, Ill.

Mr. A. Puddle Jumper,
%Gillette Publishing Co.,
400 W. Madison St.,
Chicago, Ill.

Dear Sir:

The answer to the question asked by Blank & Blank, Inc., as stated in your March issue is *no;* there are *more* miles of concrete roads in summer than in winter. Were you trying to be funny or didn't you get it?

Yours,

L. T. LEB.

Correspondence like this provides the bright spots in my daily grind. Really, I look forward to the next mail, now.

A. PUDDLE JUMPER.

• •

¶ A nail picker operated over eighty-seven miles of highway in Lampas County, Texas, not long ago and picked up 815 pounds of nails and metal scrap.

¶ It's plain to be seen that this man was not a road contractor. The following bill was presented by a painter who had been employed to touch up some decorations in an old church:

Correcting ten amendments...	$ 6.25
Varnishing Pontius Pilate and putting in front tooth.....	1.80
Mending coat of St. Peter and putting new tail on rooster	4.05
Touching up and regilding guardian angel	3.60
Washing servant of high priest and putting carmine on his cheeks	1.40
Renewing Heaven, touching up stars and cleaning the moon	9.00
Touching up purgatory and renewing lost souls.....	4.20
Taking spots off the son of Tobias	0.90
Putting rings in Sarah's ears..	1.35
Brightening up flames of hell, putting new left horn on the devil and cleaning tail.....	14.00
Two hours doing different jobs for the damned	3.06
Putting new sandals on Abraham and restoring lost tails and horns to his flocks.....	6.40
Putting new shirt on Jonah, new ropes on the vessel and enlarging the whale's mouth	2.65
Putting new leaves on Adam and Eve	.15

• •

THE OTHER FELLOW

Who is it, like a rank Traffool,
Speeds up to fifty past a school:
Who fractures every safety rule?
The other fellow.

Who cuts in front of us on turns
So that, with many damns and derns,
We set her down 'til rubber burns?
The other fellow.

Who races madly past my door
With raucous honk and screech and roar,
And does it o'er and o'er and o'er?
The other fellow.

Yet who is it, when there's wreck,
Sustains a broken spine or neck
And sees Death handing him the check—
The other fellow?
Not so. It's folks like you and me
Who wind up draped around a tree;
That wanton, reckless fool goes free—
The other fellow.

—CLAY TAYLOR.

Taken from the Texas Parade.

• •

¶ Because car windows are usually kept closed in cold weather, a high percentage of drivers abandon the use of hand signals, but—the effort of rolling down a window and giving the proper signal may save a life or prevent a costly and painful accident.

• •

¶ Highway maintenance crews occasionally make mistakes but they seldom err as grossly as the city water crew of a suburban area contiguous to a large city in Virginia. A plumber exposed a 6-inch cast iron main for a water supply to a new house. The city water crew made the tap. When the work was completed the city's workmen had not much more than left the job when a complaint call was lodged with the Water Dept. The complaint stated the pressure was "lousy" and the water smelled worse. They had tapped a sewer!

• •

¶ Forty years ago or so, the New York Sun and the New York Post got into a heated, wordy argument. In the course of the editorial battle the Post called the Sun a yellow dog. The Sun's snappy comeback was that it would continue to do what any yellow dog would do to a Post.

• •

¶ Which reminds me; did you see the drawing on page 34 of the Mar. 12 issue of the Saturday Evening Post? The scowling totem pole says, "Scram," to the spotted dog.

• •

¶ Speaking about that same issue of the Saturday Evening Post, I got a kick out of the cartoon on page 23. The artist gave his conception of U. S. 1. Not bad, I say. The road looks just about like that in some places and U. S. 1 is the main north and south road on the East Coast.

• •

¶ Holding a mountain side from sliding onto U. S. 50 just west of Prescott, Ariz., I noticed this Armco metal crib wall. The loose material apparently kept sliding onto the road

surface; the roadbed was a side hill cut. This maintenance investment was money well spent as a safety precaution. The road is crooked as a ram's horn for many miles west.

The Texas highway department reports 1,300 miles of roadway and 43 bridges, underpasses and overpasses costing $26,333,908 were under construction in that State at the start of 1938.

American Road

WASHINGTON, D. C.

NORTHWEST ROADS ASSOCIATION

Down the Road

By CHARLES M. UPHAM

Engineer-Director,
American Road Builders' Association, Washington, D. C.

SEEING AMERICA FIRST

March and April are the months of spring pilgrimages to historic houses and beautiful gardens; they are the months of blossom time in Dixie, of flower shows and fiestas, when the open road beckons most temptingly. In the spring, hundreds of thousands of American motorists travel the highways to beauty spots that have been contemplated all winter in the coziness of respective chimney corners. But, no matter how beautiful or historic a spot may be, few people are willing to beat a path to its door. They want to travel to it in comfort over a broad, smooth, safe highway.

The growth in popularity of these spring pilgrimages, flower trails and fiestas is directly traceable to their easy accessibility by good roads. For instance, Mississippi has in the past few years been increasing its expenditures for road improvements. As a consequence, down in Natchez, ancient Mississippi city "under the hill" of red clay bluffs on the banks of Old Man River, lovely ladies in curls and crinolines will be hostesses to increased thousands of visitors who will go there by automobile from all parts of the nation during the Seventh Annual Garden Club Pilgrimage.

Farther south, on either end of the "American Riviera," the older cities of New Orleans and Mobile stage their springtime festivals conveniently close to the Natchez pilgrimage. The New Orleans Spring Fiesta, coming close on the heels of the annual Mardi Gras which has already attracted countless visitors, is the mecca of many more tourists a majority of whom drive the 170 miles from Natchez via U. S. Highway 61-65. From New Orleans these same motorists, in increased numbers each year, continue 140 miles on good roads over the Old Spanish Trail, which borders the Gulf Coast, to the other end of Mississippi Sound, where the Mobile, Alabama, Azalea Trail is now at the height of its glory. Thus, the American tourist can visit the "blossom belt" of the Deep South, travelling in comfort and safety through three states over 310 miles of good roads.

In the East motorcades are planned to attend such lavish exhibits as the Sixty-Seventh New England Spring Flower Show in Boston and the Philadelphia show. The Virginia Narcissus Show, in historic Alexandria, and the annual visitation to Virginia's historic homes and gardens, under the sponsorship of the Richmond, Virginia, Garden Club will be high spots of April.

Information bureaus will be established to advise tourists concerning places of paramount interest in the various localities and good roads will play their usual important part in this growing business of "seeing America first."

We cannot fail to appreciate the fact that the tourist trade has suddenly become one of America's most important industries and with its growth has sprung up a new American class, the trailerites, who make their home on the road. Since the depression and with the growing unrest in foreign countries, "see America first" has become a much more popular practice and has brought about the purchases of millions of house trailers in addition to countless new cars. Every year more and more Americans are spending their vacations on the highways and they are spending their vacation dollars in the states along the way. But these tourists cannot be expected to bring their automobiles and trailers into communities where the condition of the roads makes driving unpleasant and often dangerous. It is only natural that those sections of the country with the best roads will be favored by this constantly growing army of tourists. The community that improves its roads, making them safe for present-day traffic, can expect increased income from tourist spenders.

NORTHWEST ROADS ASSOCIATION ORGANIZED AT RECENT BANQUET

Renewed interest in good roads and the continuance of an adequate highway program was awakened by the Northwest Good Roads Banquet in Minneapolis, Minn., on February 23. The principal result of this banquet was the formation of the Northwest Good Roads Association, Inc., a working, co-ordinating organization to fight for the continuation of the good roads program and to marshal strength against attempts to jeopardize the highway program of the northwestern states through curtailment of federal aid.

E. W. Moeller, managing director of the Highway Institute, Inc., an A.R.B.A. affiliate, was in charge of the banquet and meeting which was attended by 1,100 highway safety and good roads advocates, highway officials, road builders, engineers, planners, suppliers, county commissioners and highway users from Minnesota, Iowa, Wisconsin, North and South Dakota, Nebraska, Montana, Idaho, Wyoming, Oregon and Washington. Mr. Moeller is secretary of the new organization.

One of the first official acts of the association was the adoption of a resolution calling for the continuation of the federal-aid highway program. Copies were sent to President Roosevelt, Senator Carl Hayden, chairman of the United States Senate Post Offices and Post Roads Committee; Congressman Wilburn Cartwright, chairman of the United States House of Representatives Roads Committee, and the senators and representatives from the states represented at the meeting.

Speakers at the banquet included Colonel Willard T. Chevalier, president of the A.R.B.A.; Michigan State Highway Commissioner Murray D. Van Wagoner, A.R.B.A. president-elect; Congressman Cartwright, Congressman Dewey W. Johnson of Minnesota; Minnesota State Highway Commissioner Nels W. Elsberg, and Colonel O. R. Maguire, counsellor, U. S. Comptroller General. Governor Elmer A. Benson of Minnesota delivered the address of welcome and J. P. Devaney, president of the National Lawyers' Guild, served as toastmaster.

A contribution of $500 to the American Road Builders' Association has been made by the Wire Reinforcement Institute to aid in the achievement of the association's primary aims, particularly the continuance of an adequate highway program.

Builders' Review

APRIL, 1938

It has been estimated that travel by motor car, motor bus and railroad in the United States in 1936 reached a total of 236,000,000,000 passenger-miles, ar about 1,840 per capita.

ORGANIZED AT RECENT BANQUET

With Our State Groups

COLORADO

A survey and analysis covering the overhead costs of highway contracting as they affect the labor costs of operations is one of the most important activities being undertaken by the Colorado Association of Highway Contractors. A study of the premiums on performance bonds, labor bonds, public liability insurance, workmen's compensation insurance, workmen's unemployment insurance and social security insurance has been completed by the association and shows that the cost of these items approximates 15 per cent of the certified payrolls on projects.

CONNECTICUT

The directors of the Connecticut Road Builders' Association have arranged to hold open forums throughout the coming months for the advancement of the association's objectives and to aid in formulating plans for future activities. A membership drive, planned at the association's annual meeting, has resulted in an appreciable increase in the number of members. Members of the membership committee appointed by President H. Sanford Osborn are M. A. Gammino, Providence, R. I., chairman; A. I. Savin, Hartford District; Joseph Mariani, New Haven District; Daniel Deering, Norwalk District; Fred Benvenuti, New London District, and Charles Arrigoni, Middletown District.

FLORIDA

Officers of the Florida Section of the American Road Builders' Association elected at its annual convention in Miami, March 5 to 7, include John E. Ballenger of Lakeland, president, and F. B. Brinson of Tampa, vice-president. Charles M. Upham, engineer-director of the A.R.B.A., and Murray D. Van Wagoner, state highway commissioner of Michigan and A.R.B.A. president-elect, attended and took part in the three-day meeting.

GEORGIA

The Georgia Highway Contractors' Association, Inc., deserves a large part of the credit for the defeat of all bills detrimental to the highway industry introduced in the special session of the Georgia legislature. Measures involving serious inroads into funds allocated for contract highway construction and a bill seeking to abolish the State Licensing Board for general contractors were decisively voted down as the contractors, in co-operation with others vitally interested, rallied to the cause.

ILLINOIS

The following new members have been added to the roster of the Illinois Road Builders' Association: Berenz & Son, Bloomington; R. P. Devine Co., Watseka; Illinois Valley Construction Co., Ottawa; A. J. Shanks Construction Co., Watseka; Triangle Construction Co., Kankakee; Trompeter Construction Co., Peru, and R. C. Larkin Co., Chicago.

MISSISSIPPI

The first annual meeting of the Mississippi Highway Contractors' Association, Inc., and the election of directors and officers has been indefinitely postponed until after the first letting under the new program involving construction work of interest to all branches of the industry. This postponement was decided upon in order to make it possible for a broad representation to take part in the meeting, which will probably be called about the middle of April.

NEW HAMPSHIRE

The New Hampshire Good Roads Association held its largest and most successful meeting in many years in Manchester, March 9 and 10. Officers elected during this meeting are Orrin James of Northwood Narrows, division engineer of the state highway department, president; Ralph L. Kimball of Portsmouth, vice-president, and David L. Fosburgh of Concord, secretary and treasurer. George Thibodeau of Hagen-Thibodeau Construction Co. and Farwell Brown, division engineer in the state highway department, were chosen directors for the coming year.

OHIO

February saw the beginning of an important and ambitious activity on the part of one of the newest A.R.B.A. affiliates, as the Ohio Division of the American Road Builders' Association began publication of its official organ, the "Road Journal."

PENNSYLVANIA

The Associated Pennsylvania Constructors will hold its semi-annual meeting in Harrisburg the early part of April. During this meeting officers nominated at the December banquet-meeting will be elected and installed and plans and policies for the coming fiscal year will be determined. Activities of the A.P.C. during the past month have been centered in an effort to insure that the all-weather, superhighway, connecting Carlisle and Pittsburgh, will be constructed by the contract system of labor.

TENNESSEE

M. O. Allen, commissioner of highways and public works of Tennessee, has announced that he will have a program this year calling for approximately one million dollars per month. The most recent letting, on March 25, called for four projects, two grade and drain and two concrete slab.

The American Road Builders' Association has awarded $50 to William J. Doyle of Ellet, Ohio, as first prize in its Safe Highways Radio Contest. Other winners in this contest, which was sponsored by the A.R.B.A. in order to obtain the most interesting reactions of listeners to a series of addresses on safe highways broadcast through the facilities of 355 radio stations throughout the country, were Jere Warren of Nashville, Tenn., who won the $35 second prize, and Mrs. Alma Kehoe Rech of Denver, Colo., who received the third prize of $20.

THE CAUSE OF THE SUN'S HEAT AND EMISSION OF ELECTRONS

By HALBERT P. GILLETTE

THE heat of the sun and other stars was long ascribed to their continuous contraction, but this theory has been abandoned in favor of the theory of conversion of matter into radiant energy. The cause of such a conversion has been a debatable question. In 1933 the writer published what may be called a pressure hypothesis of conversion of matter into radiant energy. In its present form this hypothesis postulates the crushing of protons and electrons under great pressure and the liberation of the photons of which matter is assumed by the writer to be composed. The hypothesis has the merit of explaining not only the emission of these merits of radiant energy, but the emission also of electrons from large masses such as the earth and sun.

It is evident that if the rate of emission of photons increases as the pressure increases, then more protons than electrons suffer a heat-death; for the electrons, being much less massive, are driven by radiant pressure faster toward the surface than are the protons, thus escaping from greater pressure. Hence, for every positive proton that dies in the earth or sun, a negative electron is released at the surface. The emission of electrons by the earth has long been a puzzle. The sun's surface is known to be negatively charged, yet it has been generally believed that the sun emits equal numbers of electrons and protons. The writer's theory differs in a very important respect, for it gives preponderance to the electrons emitted from all great celestial masses.

There is strong evidence that the earth is encased in ionized shells, some of which have very great diameter. These great shells could not exist unless either electrons or protons predominated, for their diameters are so great that the acceleration of gravity would be insufficient to offset the velocities of the electrons or protons. Only magnetic attraction could maintain such shells.

Fortunately, the hypothesis of the heat death of matter under pressure can be tested quantatively, as will be shown. Based upon the hypothesis of conversion of matter into radiant energy at a rate proportional to the pressure, it can be shown that

(1) $H=k\ m^3/r^2$

H=total heat emitted by a star or planet
k=a constant
m=the mass of the celestial body
r=the radius of a solid or molten celestial sphere, e.g., the earth.

Sir James Jeans has recently revived the old hypothesis that the cores of the sun and other stars are molten. The largest planet, Jupiter, evidently has an incandescent core, for its "great red spot" is best explained by assuming that such a core is seen through a cyclonic hole in the clouds that overlie the core elsewhere. Jupiter's density is 1.34, as compared with 3.96 for Mars, 4.86 for Venus, and 5.52 for the Earth. Since Jupiter's core probably has about the density of these other planets, it follows that the diameter of its core is about 2/3 that of its visible disk. The sun's density is 1.41, which is so remarkably close to that of Jupiter as to indicate a similar ratio of core to visible disk diameter, namely 2/3. If so, the sun's core has a diameter about 72 times that of the earth's crust. The sun's mass is about 332,000 that of the earth Inserting these data in equation (1) we find that the formula indicates that the sun should emit about 7,100,000,000,000 times as much heat as the earth emits. The amount of heat emitted by the sun is accurately known, and that emitted by the earth is roughly known, the ratio being about 9,300,000,000,000 to 1. Hence, the formula gives a result only 23 per cent less than the observed ratio. This is as close an agreement as could be expected, for the estimated rate of heat emitted by the earth is based on temperature gradients in only a few deep mines and wells and no one knows what it is under the sea.

The absolute temperatures and masses of a good many stars are known approximately. Russell's Astronomy, page 740, gives these data for 12 stars of "the main sequence," which "sequence" excludes the abnormal stars known as dwarfs and giants.

From the hypothesis above outlined the writer has deduced the following formula for the absolute temperature, T, in degrees centigrade, of the incandescent shell of a star like the sun:

(2) $T=k\sqrt{m}$

Study of the data indicates that k=6,300, approximately. The mass, m, is that of the star relative to that of the sun taken as unity.

The accompanying table shows, in round numbers, the temperatures of 12 stars calculated by this formula, as compared with the observed temperature. In one case the observed temperature is 34 per cent less than the theoretical temperature, but in all other cases the difference is less than 20 per cent, and in 6 cases it is less than 10 per cent. These differences are probably within the observational errors as to mass and temperature. In any event, the agreements are too close to be accidental, and they make it highly probable that the hypothesis upon which the formula is based is essentially correct.

Equation (1) shows that the cores of all the larger planets and even that of the moon are molten. It follows that the moon is also emitting electrons. Such an emission was recently inferred by Stetson because of the moon's effect on radio reception.

THEORETICAL AND ACTUAL TEMPERATURES OF 12 STARS

Star	Mass, m	Temperature, T By Formula	Temperature, T By Observation
Beta Centauri	25	31,500	21,000
Nu Scorpii	5.2	14,400	17,000
Beta Aurigae A	2.2	9,400	11,200
Alpha Lyrae	3.0	10,900	11,200
Alpha Can. Maj. A	2.4	9,800	11,200
Alpha Aquilae	1.7	8,200	8,600
Alpha Can. Min.	1.1	6,600	6,500
Alpha Cent. A	1.1	6,600	6,000
70 Ophiuchi A	0.9	6,000	5,100
61 Cygni A	0.45	4,200	3,800
Kruger 60 A	0.26	3,150	3,300
Barnard's Star	0.18	2,650	3,100

Footnote: The sun's mass is taken as 1, and its temperature is about 6,200 degrees. The formula used here is $T=6300\sqrt{m}$ degrees Centrigrade, absolute. This formula is based on the writer's theory of "heat death" of matter as a result of great gravitative pressure.

Since luminescence increases as temperature rises, it follows that the luminescence or "absolute magnitude" of a star must increase as its mass increases, if the pressure hypothesis of conversion of mass into radiant energy is correct. But since we see a luminous gaseous shell and not the molten core of a star, allowance for the distance of such a shell from the core must be made in deducing the luminosity of the shell. By doing this the writer has deduced the following formula for the luminosity, L, of stars of "the main sequence":

(3) $L=K\ m^{3\ 1/3}$

in which K is constant and m is the mass of the star. The value of L is deducible from the "absolute magnitudes" by simple formula. This formula fits the observed facts so closely as to indicate its fundamental soundness.

There is a remarkable, and hitherto unexplained, relationship between the luminosity of certain stars and the period or cycle during which their luminosity waxes and wanes. These periods for Cepheid stars are relatively short, nearly all being less than 100 days, and the majority averaging about a week. The shortness of the periods suggests that it may be due to the rotation of the star or its electron-shell that is loaded with incandescent atoms. Since many of the electrons escaping from a rotating star would move in spirals around its axis toward both poles, according to the principle of magnetic rotation, they would impart axial rotation both to the star's molten core and to its encasing electron-shells. Electrons would issue in great numbers from around the stars' magnetic poles, and in greatest numbers from around the magnetic pole in the hemisphere, because of the electric repulsion of cosmic electrons upon the hemisphere facing in the direction of the stars' motion. Our sun shows such an effect, for the majority of its electrons escape from the southern hemisphere, as is shown by the normal preponderance of sun spots in that hemisphere. There are also terrestrial evidences of this, which will not be discussed now. Let a great stream of spiraling electrons issue around the south pole of a star, and it will act like the beam of a searchlight, which is most brilliant when directed toward the observer. Let the star rotate axially in 7 days and that beam will be directed earthward every 7 days and then cause an increase in the luminosity of the star. Based on this hypothesis, and on the hypothesis of emission of electrons as a result of gravitative pressure, the writer has deduced the following formula:

(4) $P=k\ m^4$

in which P is the period of axial rotation, k is a constant and m is the mass of the star.

Combining equations (3) and (4) we get:

(5) $L=c\ m^{\ 5}/_6$

in which c is a constant.

This mass-luminosity formula fits the observed facts as to variable stars whose periods range between 3 and 100 days so well as to indicate that the agreement is not accidental. These are the Cepheid stars or short-period variables.

There are long-period variables, most of whose cycles of luminosity are about a year long, or about 50 times as long as the typical short-period variable. This indicates that if the cycle of the short-period stars is due to axial rotation, that of the long-period stars is due to orbital revolution, such as that of a planet around the parent star. There is strong evidence that streams of electrons constantly flow from the sun to the earth, and that the strongest stream is from the sun's southern hemisphere. Those streams cause auroral luminescence, which, if it were considerably greater, would lead an observer on a very distant planet to regard the sun as a star of variable brilliance, whose period is just a year, for the greatest luminesce would occur when the earth was "in opposition," as is our moon when full. Moreover, at that time the beam of solar electrons, loaded with atoms, would be moving directly away from the observer on the distant planet, as his spectroscope would disclose. Now, this is precisely what is the case as to long-period stars, and a very puzzling case it has been, for the exact opposite occurs at the time of maximum luminescence of the short-period stars, namely, spectroscopic evidence that luminous material is moving toward us. The hypothesis above, given to explain the short-period stars, not only explains the cause of their periodicity, but why their luminosity is greatest when the stream of electrons and atoms is coming toward us.

It is noteworthy that these explanations of stellar periodicity are derived in a very simple way from a basic hypothesis that was not devised to explain them. Moreover, this basic hypothesis also explains why the earth is encased in a series of electron-shells, some of which have such an enormous diameter that it takes several minutes for a radio signal to be "echoed" back to the earth. It shows why the sun has a well defined spherical corona, whose diameter is double that of the photosphere. And it throws light upon the cause back of Bode's empirical law of planet distances from the sun, indicating that planets developed in a series of solar electronospheres loaded with atoms carried there by high-speed spiraling electrons emitted from the sun. At the same time, it accounts for the angular momenta of the planets without resorting to a cataclysmic hypothesis, such as that of sun disruption by a passing star.

▼

Truck Haulage in Illinois

Important facts regarding truck haulage in Illinois were brought out in the hearings of the Uniform Motor Vehicle Laws Commission of the Illinois General Assembly. Some of these facts follow:

Two hundred and forty-four thousand, one hundred and fourteen trucks, trailers, and busses were licensed in Illinois in 1937.

More than 300,000 men are employed as drivers and helpers on these trucks.

Eight million tons of coal (20 per cent of the total, exclusive of that sold for locomotives) were transported from mine to consumer by trucks in 1936.

One thousand and fifty-six Illinois coal mines are not served by railroads, but are entirely dependent upon trucks.

More than 50 per cent of the livestock handled in the Chicago Union Stock Yards (the largest in the world) is carried from the farm in trucks.

Eighty-five per cent of the livestock delivered to National Stock Yards at East St. Louis (second largest market in the world) moves in trucks.

More than 95 per cent of all milk is brought to cities by trucks.

A majority of fruit and vegetables produced in Illinois is moved from farm to market in trucks.

Eighty-nine million, two hundred sixty-three thousand and ten pounds of butter and 2,477,696 cases of eggs (30 dozen eggs per case) were brought into the city of Chicago in 1936 by trucks.

BITUMINOUS ROAD MATERIALS

A Survey of Developments for 1937

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PART II—Periodical Literature

A REVIEW of the periodical literature of bituminous materials for any one calendar year will always lead to several difficulties as far as presenting up to the minute developments are concerned. One is that the printing of proceedings is often delayed, so that material presented at meetings does not always appear in print the same year as the meetings were held. Another difficulty is that many foreign journals are not available, and abstracts of them often do not appear until months later. Bituminous literature covers a wide field of investigation and an appropriate discussion of the material would require space equivalent at least to that of a book.

Chemistry of Bituminous Substances

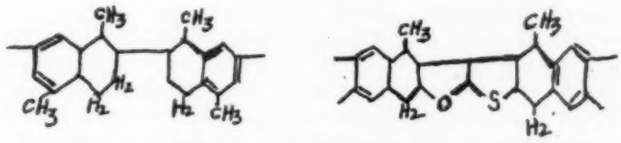
The use of solvents appears to be the best approach which has been utilized in the study of the constitution of asphalts. This is mainly due to the failure of distillation methods, the inertness of asphalts to chemical reagents and the complexity in the nature of asphalts. Methods similar to those recently proposed for the analysis of oils and tars may possibly be developed for use with asphalts. The method of Fisher and Eisner[20] for the analysis of hydrocarbon oils is based on changes in volume and physical constants caused by progressive removal of olefins and aromatics by sulfuric acid. The density and refractive index rise to maximum values at the point of complete olefin removal. Beyond this point, the values fall as the aromatics are removed, becoming approximately constant when the residual oil consists only of saturated hydrocarbons. The method of Hall and Cawley[18] used in their investigation of products obtained by the hydrogenation-cracking of low-temperature tar consists in the determination of olefines with 80 per cent sulfuric acid and aromatics with 95 per cent H_2SO_4 and the determination of naphthalene and paraffin hydrocarbons in the material, after removal of olefins and aromatics by means of the aniline, calculating the composition from the data of Griffith and Garner.

Hillman and Barnett[13] investigated asphalts by a solubility method, involving solvents of varying internal pressure, e.g., isopentane, hexane, CCl_4, benzene, CS_2, and pyridine, and also propane containing various amounts of ethane or methane. The conclusions regarding the nature of the cracked and uncracked asphalts which they studied were:

(a) maltenes from cracked residues possess a more aromatic nature than the maltenes of the straight run asphalt.

(b) asphaltenes in low-level cracked residue for the particular Californian crude examined are of less molecular complexity than the uncracked ones.

(c) asphaltenes may be represented by structures such as the following:



In a series of articles, Ichikawa[25a,b,c,d,e] has presented some views regarding the chemistry of asphalts. He advances a theory of the polymerization of naphthene hydrocarbons and concludes from his experiments that: (a) the general properties of asphalts made from an asphaltic-base and a mixed-base crude oil are the same, (b) asphaltic-base hydrocarbons are polymerized by air blowing to a greater extent than mixed base, (c) asphaltenes from straight asphalt are more brittle, and the molecular volume is ⅓ as great compared to blown asphalt, and (d) the petrolenes from straight asphalt are harder and more cohesive, and have a larger molecular volume than those of blown asphalt.

Graefe[24] suggests that the asphalt in Trinidad Lake was formed by petroleum flowing into hot volcanic mud followed by condensation of the hydrocarbons under the influence of air, light, and sulfur with the elimination of hydrogen. Hradil[23] has studied the sulfur and other type compounds in rock asphalt, and supports the theory of their vegetable and animal origin. Berl[22] considers that asphalts were formed from plant residues under influence of microbes, time and pressure, and that the process required eons of time, which can be repeated by man by using higher temperatures and pressures. Sanders[16] links the asphalt content of cretaceous crude oils with the vanadium complexes present. Branke[17] has pointed to the high content of asphaltogenic acids and their anhydrides (up to 50 per cent) in the bitumen of the Nutovsky asphalts as an indication that the bitumen is in a greatly advanced state of oxidation.

Of the various methods of classifying the components of asphalts, Martinenghi[15] considers that those of Marcusson, Richardson, and Hofer are the most serviceable. A method of solvent separation using pyridine, benzene, and light petroleum (b.pt. 40-60° C.) has been extended to the study of tars by Adam, Shannan, and Sach.[11]

The determination of tar acids and bases by contraction methods are affected by (a) solvent power of alkaline phenolate solutions for ammines and (b) absorption of water by the oil layer. To overcome these factors, Fisher and Eisner[21] recommend the following procedure:

(1) Use NaCl solution to determine adsorption of water by the oil layer.
(2) Extraction with K_2CO_3 solution to indicate carboxylic acid content.
(3) Successive extractions wtih mineral acid and alkali.

Physical Properties

Traxler[104] has described a viscometer, which utilizes the principle of the falling coaxial cylinder viscometer,

and which makes possible the determination of the viscosities of asphalts at service temperatures as quickly as a test can be made with the penetrometer. Thelan[38] proposed a method of studying the rheological properties of asphalts by the use of the New York penetrometer as prescribed by the A. S. T. M. In this method, the needle is allowed to sink into the asphalt for a series of successive time intervals without the operator touching the asphalt or needle. Rhodes and Volkmann,[39] however, point out some fallacies of Thelan's deductions with respect to his method. An improved ductility machine has been developed by Thurston and Cummings,[42] which features improved temperature control and visibility and placing the driving mechanism outside the bath.

Traxler and Coombs[7] regard asphalts as imperfectly elastic fluids, the elastic and viscous deformations occurring simultaneously upon application of a shearing load. They state that age-hardening is a manifestation of thixotropy and that the increase in viscosity can be overcome by heating or mechanical working. They found (1) that asphalts with high rates of age-hardening and definite deviations from viscous flow give characteristic microscopic patterns when the surfaces are etched with ethyl ether or 86° Baume naphtha. They postulate a solgel transformation to account for the increase of viscosity with time. Nellensteyn[9] summarized his reasons for supporting the theory that asphaltic bitumen is a highly protected lyophobe sol with a carbon kernel, and discussed further his surface tension rule for the solubility of asphalts in different solvents.

The viscosity-temperature susceptibility coefficient has been proposed as a suitable index of the rate of change of viscosity with temperature.[5,6] The coefficient is determined by the equation:

$$\text{V.T.S.} = .221\,\frac{\log\left(\dfrac{\log u_1 + 0.8}{\log u_2 + 0.8}\right)}{\log \dfrac{T_2}{T_1}}$$

where u_1 and u2 are the kinematic viscosities at the absolute temperatures T_1 and T_2.

Fuidge and Deadman[4] studied the relation of the Ring and Ball softening point to the equi-viscous temperature and found that roughly, equi-viscous temperature = softening point (R. & B.) + 18.5° C. The equi-viscous temperature is the temperature at which the tar has a viscosity of 50 seconds when measured on a standard tar viscometer (T.P.T.C., 1929, p. 63). The conversion of viscosity at any one temperature to E.V.T. is given by the equation[3]:

$$t\,\theta^n = 50\,\theta^n{}_1$$

where t = time, θ = °F., θ_1 = equi-viscous temperature and $n = \dfrac{\theta_1}{10.9}$.

The production of asphalts of desirable consistencies and susceptibilities by blending has been discussed by Holmes and Raphael[10]. They call attention to the fact that asphalts having better susceptibility characteristics than oxidized asphalts can often be produced by blending oxidized asphalts with soft fluxes and oils, the improvement to be obtained being dependent upon the crude source and the relative consistencies of the oxidized asphalt and fluxing agents employed. Results were presented of a study of the properties of asphalts prepared by blending precipitated asphalt, precipitated resins and deasphalted oil obtained from a multistage propane precipitation of a Mid-Continent residuum. They found among other things that asphalts of better or poorer quality than the pipe still produced products can be obtained depending upon the choice and proportion of the constituents.

Testing of Bitumens

The improved Oliensis spot test was studied by Lewis and Welborn[41] using variously treated asphalts, determining the highest percentages of gilsonite or xylene which will give a positive stain and also the lowest percentage of gilsonite or xylene which will give a negative stain. The method according to their findings tends to indicate the degree of heterogeneity, whereas the original Oliensis test shows that the asphalt in question is either homogeneous or heterogeneous. Schweyer and Howell[36] developed a method for determining the staining propensity of asphalt, which comprised placing the sample between pads consisting of 16 sheets of a special grade of paper under a given load at 54.4°C. and evaluating the staining propensity by the number of sheets discolored.

Schaefer[40] has developed a modified Spitz-Hönig method for the determination of naphthenic acids in asphalt, together with a rapid titrimetric method suitable for routine tests, and an inexpensive laboratory method for the recovery of acids from redistillation asphalt. An improvement of the standard titration method for determining the saponification value of asphalts and asphaltic oils suggested by Fratis and Condit[37] involves the use of a special titration flask. This is an Erlenmeyer flask with a tube sealed so as to reach ⅓ around the flask near the bottom. By tilting, the aqueous layer alone enters and affords a close observation of the end-point.

Weathering Tests

The problem of the weathering of asphaltic materials is receiving attention in various laboratories. Accelerated tests such as those developed for paints are being utilized. Thurston[30] prepared synthetic asphalts compounded from asphaltenes, resins, and oils separated from various sources and subjected them to accelerated weathering conditions. His data indicated a possibility of improving asphalts for some specific purposes where special characteristics are desired. Snoke and Gallup[26] testing mineral-surfaced asphalt shingles in an accelerated weathering tester found that the type of asphalt and manufacturing process appears to be the influencing factors, rather than the type of surfacing material. Zapata[27] made weathering tests with films of slow-curing oils and followed the changes by determining unsaturates, hard asphalts, soft asphalts, oils, and resins. As a possible aid in evaluation of the weathering tests, changes recurring in mats built during 1936 were followed by determining hard asphalts, soft asphalts, resins and oils.

Lewis and Hillman[28] exposed slow-curing liquid asphalts in thin films to sunlight, heat, and air. They found that the thinner films had the greatest losses and gave the hardest residues, and that final residues had high percentages of material insoluble in 86° Be. naphtha, and in the case of the cracked products large amounts of material insoluble in CS_2 and CCl_4. The residues from exposure had considerably more material insoluble in 86° Be. naphtha than the amount calculated by considering the loss of volatile matter. Douglas[29] points out that the effects of weather on bitumens are decreased ductility and tensile strength, decreased adhesiveness, increased hardness and increase in free and fixed carbon.

Adhesion

The adhesion of bituminous materials to mineral surfaces is a problem of importance when considering the behavior of bitumen-aggregate mixes in roads. Mattimore[45] suggests the use of three methods for testing adhesion between bitumen and aggregate, namely,

(1) the water test which consists in shaking a mixture of bitumen and aggregate for one hour with water at varying temperatures.
(2) the solubility test conducted in such a way that the mixture is treated with varying quantities and subsequently subjected for one hour to water at ordinary temperature.
(3) the sodium carbonate test in which the mixture is subjected to the action of sodium carbonate solutions of different concentrations.

These tests are claimed to check very closely with results in practice. Temme[46] has discussed the intersurface relations in bitumen-mineral mixtures and Ebberts[42] has proposed a modification of the Bartell displacement pressure method for measuring adhesion tensions.

In regard to the question of adhesion, various investigations differ as to the relative importance of the bitumen and the aggregate. Ramchandani[44] found that there was no direct relationship between adsorptive capacity and chemical composition of the aggregate. He explains the difference in aggregate as due to the structure of the surface. Mattimore[45] maintains that the composition of the stone exerts more influence on the adhesiveness than the bituminous binders themselves, in that stones of acid nature such as quartzite, granite, seyenites, etc., furnish poor adhesion with bitumen, while stones of basic nature produced good adhesion, although a few exceptions have been noted. Ebberts[42] pointed out the value of adding polar molecules to asphalt. Ramchandani[44] studied the adsorption of the different constituents as separated by the Marcusson method and found that asphaltenes were very much more strongly adsorbed than the resins and oils. He also found that asphalts with a higher percentage of asphaltenes were more strongly adsorbed than those with the lower percentages.

There can be little doubt that adhesion of bitumen and aggregate depends on a number of variables including the physical and chemical properties of both bitumen aggregate. Zaleski[48] indicates that when mixtures of bitumen and aggregate are heated, the changes which occur in the mix are due more to absorption of bitumen rather than to changes in the bitumen itself.

Cardia[47] attributes the differences in adhesion in mixtures of tar and rock-asphalt to the chemical characteristics of the rock asphalts. McColough[08] confirms the reports of others the necessity of using clean gravel in order to prevent stripping of the bituminous material.

Testing of Bitumen-Aggregate Mixtures

The testing of aggregate-bitumen mixtures is the subject of a number of papers and should receive a more detailed consideration than can be given here. The need of appropriate test methods is apparent from the number which are constantly appearing. Bencowitz[52] has suggested a procedure for the design of asphaltic mixtures which consists of determining the brittleness and stability of the mixture. The brittleness test involves tumbling briquettes in a rotating cylindrical drum and taking the percentage loss in weight after an hour as a measure of the brittleness. The stability test is performed by measuring the maximum load required to force a sphere ¾ in. in diameter into the specimen to a depth equal to the radius (⅜ in.). The brittleness test is taken to establish a minimum asphalt content and the stability test to indicate the best mixture in reference to suitable aggregate composition. Pfeiffer[51] has devised an apparatus, which he has designated the Cell Test, for correlating bitumen content in mixes under load with (a) the angle of internal friction, (b) specific viscosity resistance, and (c) initial resistance. The apparatus is essentially an India rubber cylinder held in a vertical position by steel flanges at its upper and lower ends. The test block of material is placed in the cylinder and a load is applied hydraulically to the upper horizontal surface of the test block, while the lower horizontal surface is held rigidly. Movement of the test block is transmitted through the rubber to a fluid which fills the annular space between its walls and those of a metal cylinder containing it. The pressure on the fluid is measured by a gauge and the rate of application of the load is measured by the outflow of the fluid from a needle valve.

Lee and Markwick[55] have studied the behavior of bitumen-aggregate mixtures under constant stress and from their results concluded (a) the effect of binder content on the resistance to deformation is very defined, (b) repeated loadings on shear specimens show that the percentage elastic recovery on each cycle of strain increased with repeated loading, (c) the cause of ageing is not due to evaporation or oxidation, as paraffin coated samples showed the same changes in properties as uncoated specimens, (d) aged specimens upon heating and remolding showed the same changes as similarly aged specimens not heated or remolded, (e) the increase in rate of shear with increased applied stress cannot be explained by viscous properties alone.

Macnaughton[53] has investigated changes which take place in bitumen-aggregate mixtures under compression. Some of the conclusions which he made from his results are: (a) pneumatic compaction appears to be more suitable than direct compression for forming specimens of paving mixtures in the laboratory, (b) consolidation of bituminous paving mixtures under traffic proceeds for a considerable period of time after the pavement is first laid, (c) during consolidation some degradation of aggregate occurs, with the formation of a larger proportion of fines in the mixture (d) degradation may proceed to such an extent that aggregate void space may be materially reduced, and the stability of the mixture impaired on account of the presence of an excess of liquid.

Vokac[71] has presented some preliminary results of an investigation on the correlation of laboratory tests and service behavior of asphaltic mixtures. The results do not substantiate some of the commonly accepted theories and tests. The Skidmore shear test, the Hubbard-Field stability test, the impact test, and the modulus of elasticity were not indicative of the service behavior, whereas the compressive strength and elastic limit gave more parallel results with service behavior.

Rader[73] has suggested that the modulus of rupture and the modulus of elasticity are measures of the resistance to cracking of sheet asphalt paving mixtures and appear to be suitable control tests for use in designing asphalt paving mixtures to resist cracking. Rader also pointed out that toughness of a paving mixture at low temperature is a measure of the resistance to impact and may be used as a control test to evaluate mixtures with respect to their ability to withstand the action of traffic at low temperatures.

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Rashig and Doyle[72] have compared various asphalts when made into a standard pavement mix and tested in flexure and examined various physical properties of asphalts extracted from samples cut from sheet asphalt pavements. They concluded from their study that certain tests commonly used in refinery control work and for identification purposes are not measures of quality as has been supposed. From their tests on extracted asphalts, they concluded that those mixtures having the highest penetration asphalt and the highest ductilities consistent with stability will prove the most resistant to cracking and also present the longest wearing life.

Easterbrook and Stratford[100] attempted to correlate composition of several asphalts, e.g., asphaltene, resin, and oily constituents, with road behavior, but found no relation between the composition of the asphalts and their stability as a binder.

The bituminous laboratory of the city of Detroit[50] not only make specification tests for their asphalts, but also test the paving mixtures for asphalt content, mineral aggregate grading, and stability. For purposes of research and preparing experimental mixtures, a twin pug-mill type mixer is used, which is motor driven, steam jacketed and has a capacity of ½ cu. ft. of material.

Asphalts and Mineral Fillers

It has been shown by Traxler, Schweyer, and Moffat[54] that a linear relation exists between the logarithm of the viscosity of viscous mixtures from a particular liquid and a particular pulverulent solid and the volume per cent of the solid present. They have called the per cent increase in viscosity resulting from an increase of one per cent by volume of filler the Stability Index, and have stated that it is independent of the nature and viscosity of the liquid providing no chemical reaction occurs. Traxler[104] has given evidence that "bulk density" or "volume weight when compacted," which has been used as a method of determining the efficiency of fillers, is inadequate as a means of evaluation. The Stability Index is maintained to give a more accurate evaluation of a filler, although the void content is a better indication than the "volume weight when compacted." Bollen[102] has discussed the methods of selecting and evaluating mineral fillers, particularly soils, and suggested that in using the method of Miller and Traxler in evaluating fillers, castor oil or a standardized asphalt could be used as a standard so that investigators could express the Filler Stability Index in the same terms.

Gerlach[49] in an investigation of the coverage of fillers by asphalts determined the uncovered particles quantitatively by dye adsorption from a safranine solution in water after shaking for 3 minutes. His tests showed that in commercial type mixers, coverage was over 95 per cent completed in 30 seconds and continued more slowly thereafter. Ease of covering increased with increase in particle size.

Recovery of Asphalts

The separation or recovery of bitumen from mixtures of bitumen and aggregate has led to various opinions as to the conditions for making the separation and also removal of the solvent from the bitumen. Chalk[31] proposed a method, using CS_2, as an improvement to the method of Greutert. The CS_2 is removed by distilling the bitumen solution in an atmosphere of CO_2 by heating in a water bath, then distilling at a higher temperature using an oil bath and reduced pressure. Physical tests on the original and recovered asphaltic bitumen checked very closely. Ashworth[32] found that extraction of a naturally impregnated limestone yielded only 5 per cent bitumen with cold CS_2, whereas boiling with trichlorethylene showed 9.5 per cent bitumen. The bitumen extracted with the trichlorethylene was soluble in CS_2. His explanation was that the adsorption of certain of the hydrocarbons of the bitumen by the mineral matter was strong enough to resist solution by CS_2 but not by trichlorethylene. Chalk[33], however, suggested that the material insoluble in CS_2 but soluble in other reagents consists of organic matter present as soaps and as pyrobitumen.

Relative to the question of the recovery of asphalts from benzene solution, the question has come up as to the effect of light, time, and the method of removal of benzene on the consistency of recovered asphalt. Abson[34] discounted the effect of light as a hardening agent, and attributed a hardening effect in the Bussow method to excessive heating but which was counteracted by the retention of benzol. Bussow[35], however, indicated that in the short time involved in the method and in the absence of light hardening would not take place, excepting experimental error.

Asphalt Production

The deposit of natural rock asphalt in the Val de Travers Canton of Neuchatel has been operated for over 60 years as the leading producer of rock asphalt[56]. The average bitumen content is 8 to 9.5 per cent and is readily soluble in carbon disulfide. The production of asphalt from New Mexico crude oils at Roswell, New Mexico, as described by Born[58], was the first vacuum unit type asphalt plant in that state. Carney[57] has described the methods of manufacture of various grades of asphalt in pipestill and vacuum tower from heavy Arkansas crudes.

Rubber and Bitumen

Rubber as an addition agent for bituminous material is receiving recognition for various uses, and its extended use has evidently been only limited by its cost. Broome[62] has shown that rubber can be conveniently incorporated with asphalt by dissolving the rubber in a light flux oil and cutting back the bitumen with the rubber-oil flux. He has also shown that percentages as low as 1, 2 and 3 per cent rubber raises the softening point and decreases the penetration without reducing the ductility. Rubber-asphalt road mixes laid in 1935 have proven satisfactory. The California Division of Highways[63] have developed an improved joint filler composed of bitumen and commercial rubber latex. Combinations of rubber and tar products have been used for preparing plastic materials[64].

Emulsions

The principles governing the kind and amount of emulsifying agents and stabilizers to be used with any particular asphaltic bitumen are still to be exactly defined. Flavigny[59] has made a step in this direction, however, and has suggested that the choice of a stabilizing agent for a bituminous emulsion will depend on the content of active agents in the bitumen. An inactive bitumen, he maintains, requires an agent with both emulsifying and stabilizing power, while one that already has a low interfacial tension between bitumen-water requires stabilizing. The acid number of a bitumen does not necessarily show its emulsifying tendency, since acids of low molecular weight have emulsifying power, while those of higher molecular weights have stabilizing power.

The use of emulsified bitumens is increasing in the case of low cost roads[94] and with certain types of road surfacing[61]. Haller[94] has shown that the type of emulsion to be used in any particular case depends on the

type of soil being stabilized and has developed an empirical method for determining the treatment needed, e.g., by measuring the particle size distribution in the soil. In stabilization of soil with emulsions, Flinn[90] considers that after evaporation of some water, the high surface tension of the remaining water stretches the asphalt globules into thin films which are drawn around the soil grains. This changes the character of the asphalt, and the film, which is not appreciably thicker than the adsorbed water film normally present, waterproofs the clay particle.

Kleinert[60] studied the effect of temperature variation, rate of cooling, and period of exposure upon a series of emulsions of varying degrees of stability and found that the rate of cooling was of greatest importance. The stable and semi-stable types as determined by the DIN and International tests were more resistant than the labile.

Tars

Tar is being used in (a) penetration macadam, (b) re-tread, (c) gravel treatments, (d) chemically stabilized gravel, (e) airport surfaces, (f) concrete maintenance, (g) block filler, and (h) base stabilization[58]. The tars of low viscosity are used for prime coats and surface treatments, intermediate viscosity tars for surface treatment, and re-tread, while those of higher viscosities are used in surface treatments, pre-mix, re-tread, seal coat and penetration. In the re-tread method using tar as binder, good results depend on (a) production of suitable aggregate, (b) good workmanship, (c) selection of bituminous binder suitable to aggregate and (d) time of year[84]. Thin tar carpets have been reported as giving satisfactory results for the 2 and 3 years that they have been in service[79]. Rhodes and Gillander[81] investigated the effects of (a) evaporation, (b) oxidation, (c) polymerization, (d) water and (e) light on road tars to determine the predominant factors in the weathering of tar. Evaporation and oxidation were found to be the most important factors, with polymerization, water and light having only small effects.

Tars are being used and investigated to some extent in the construction of low cost roads. Stephenson[82] points out that for such purposes tar has the advantages of being easily worked and sets slowly to give sufficient time for manipulation, but that it has the disadvantage of susceptibility to heat, which necessitates avoiding an excess, which will cause bleeding. Martin[92] states that very heavy clay soils are more easily mixed with light tars, ranging in Engler specific viscosity at 40° C. from 5 to 35, whereas heavier tars are required as soils become more sandy. Rhodes and Havens[88] recommend the use of (a) TM-1 and TM-2 (viscous at room temperature) for sandy soils, which need stability and not water proofing, (b) TC-1 and TC-2 (low viscosity) for clay soils which need waterproofing not stability, and (c) TC-3 and TC-4 (intermediate viscosity) for silt soils low in clay, which needs both stability and water proofing. Soils having poor physical characteristics as a base for surface treatments were stabilized with tar in an experimental road in North Carolina. The two methods used, e.g. (a) mix of 4 in. thickness and (b) sandwich type with 5 in. untreated soil core and two 1 in. layers of tar mix, were still in satisfactory condition after six months. Adam and Potter[12] have reported that specifications on tar alone do not indicate their true action when combined with aggregate, but that adhesion, rates of drying, durability and stability are also important.

Use of Asphaltic Bitumens in Road Construction

A discussion of the recent developments in the use of asphalt for road and street construction has been given by Gray[70]. He stated that MC products should be used with absorptive stone and RC with non-absorptive stone and that MC-3 is recommended for use where little or no 200-mesh material is present in dense graded road mix construction. He also reported a growing use for MC-3 for seal coat, and the MC-1 was usually recommended for primes in surface treatments, but MC-2 has been found better in many cases, the criterion being the presence of 200 mesh material. Gray has also discussed the design of bituminous type pavements[77] and the construction and maintenance of these roads[75]. Lee[68] has presented a description of the origin and uses of asphalt in road construction; and some recent developments in bituminous roads and road materials have been given by Eckert and Winterkorn[106] and Von Skopnik[66]. Emrey[97] has described various types of low cost highways, e.g., re-tread, mulch, carpet coat, and double surface treatment. Westsmith[89] has reported methods of bituminous surfacing used in Wyoming, and Goshorn[102] has described the methods employed in Ohio for resurfacing old pavements with plant-mixed material and road-mixed material.

Reagel[99] and Reagel and Schappler[97, 98] have described the methods of soil stabilization used in Missouri, e.g., the traveling plant method and the sub-oiling method. In the sub-oiling method, emulsions are used, as fractionation occurs with cut-backs as the asphalts diffuse through the soil. The mixing method although more expensive gives a more complete and uniform diffusion. Critz and Sligh[91] have reported the results of stabilized sandy-soil roads constructed in South Carolina in 1927. The soil was predominantly sand with a clay of poor binding power and was stabilized in various sections with cold and hot application tars and RC and SC asphaltic materials. Surface failures which occurred were traced to subgrade failures, improper proportions of bitumen and soil, and surface enrichment. The RC asphalts were found to contain about 50 per cent of its volatile matter 7 years after the material was constructed, and the SC oils whose fluidity decreased because of weathering developed some binding property but produced mixtures that became brittle and did not rebond without additional oil. Miller and Klinger[105] have presented the results of an investigation in West Virginia, in which they made a laboratory study of the penetration and mixed-in-place methods of stabilizing soils and also constructed an experimental road by the mixed-in-place method. Their laboratory study indicated that the mixed-in-place method was more satisfactory than the penetration method and would be suitable for any type of soil likely to be encountered in West Virginia. In the experimental road, asphalt emulsion and tar were used to stabilize soil by the mixed-in-place method, and MC-2 asphalt used to stabilize a gravel section.

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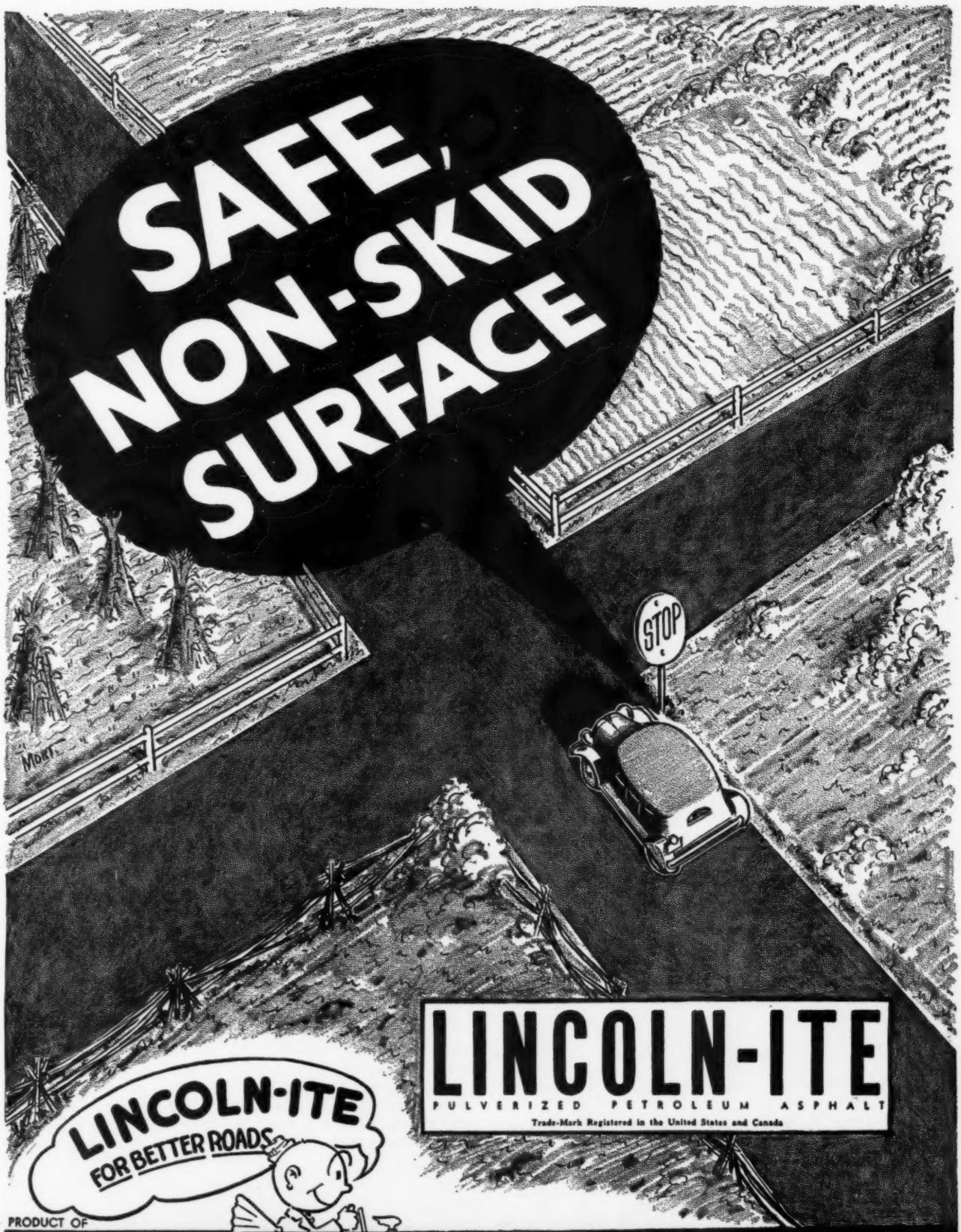
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Michigan County Road Commission Adopts Annual Wage System

On February 1 all employees of the Road Commission of Macomb County, Michigan, were placed on an annual wage basis. The plan is intended to assure the men a steady income and to permit the Commission to operate on a fixed budget. The Commission maintains 1,405 miles of road, with an average annual income per mile of $218.

Under the old hourly wage plan, the number of men employed varied from a peak of 250 in the summer to a low of about 80 in the winter. It is now planned to keep the present force of 152 persons at work throughout the year. The payroll is "spiked" at approximately $18,000 a month. All possible work will be done in the winter months, with the summer reserved for work that can be done at no other time.

Under the new system all employment is based upon a service record of 40 hours per week and 52 weeks per year, but the men are subject to call at any time when services are necessary. All employees are credited with 40 hours which they may use for a vacation period or use for making up lost time.

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Gas Tax Birthday

On February 25, 1919, the first gasoline tax law in the United States went into effect in Oregon. The rate was 1 cent a gallon. In 1920, the first full year of gas-tax collection brought in $1,363,902; the tax had spread to five States. Today every State has a gasoline tax and there is a Federal tax besides. In 1937, State and Federal gasoline taxes yielded $972,325,000, an average of $32.79 per vehicle. This is double the average impost of 1929.

In these nineteen years, some $7,000,000,000 has been collected from American motorists.

If all of it had been applied to construction and maintenance of highways, the nation might have a highway system to be proud of. Since this is a tax based not on ability to pay, but on benefits received, its use for any other purpose than highways cannot be justified, and gas-tax diversion is morally no better than theft of trust funds.—*Los Angeles Times.*

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By JULIAN GREENUP
Commercial Attaché, Lima, Peru.

WITH the asphalting in 1936 of some 50 miles of the Central Highway of Peru beyond Chosica, thus affording a 75-mile hard-surface road eastward from Lima; and the extension in 1937 of the same kind of surface from a point near Chorrillos to Pisco, a distance of 155 miles south of the Capital City, Peruvian motorists were enabled for the first time to drive safely and comfortably at high speed in a single direction during a period of more than one hour. On the other hand, airplanes have been rendering regular service as rapid, long-distance passenger and even freight carriers for almost a decade.

The reason for this uncommon development, as compared with many other nations, is a colossal combination of precipitous mountains, sandy deserts, and soggy jungles which challenges the national budget. After winding, climbing and clinging for only 86 miles, the Central Highway at Anticona Pass reaches an altiture of 15,860 feet, which is higher than any terrestrial point in the United States.

Barring only the far north, the coast is without rain, and level-to-mountainous desert sands and rock are encountered by the roadbuilder as a rule rather than as an exception. From the highlands, the engineers and motorists work downward, and upward again over the second cordillera or range; and then over the third before leveling off into the fastnesses of the damp Amazonian forests.

On December 8, 1936, General Oscar R. Benavides, President of Perú, declared in a message to the nation that for many years the government should charge itself primarily with the highway problem, because the barriers are hindering the exploitation of wealth, the growth of commerce and cities, the development of agriculture, and the cheapening of foodstuffs. A three-year program,

American Rock Crushers, Working on the Central Highway of Perú at an Altitude of 4,300 Meters.

Rock Crusher, Cement and Asphalt Mixers on the Pisco-Ica Highway.

to cost S/50,000,000,* was instituted immediately thereafter.

The project embraces all new construction and repair work on every route considered absolutely necessary for vigorous progress at the present stage of the nation's economic development, and Perú's section of the Pan-American Highway falls conveniently within the program. Although the total expenditure envisaged may at first sight seem rather small, the S/20,000,000 allotted for 1937 application amounts to 13% of the entire budget of revenues. The same ratio in the United States would involve the sum of $500,000,000, so that Perú's undertaking, proportionally, is above the general average, and on the level of the greater nations most active in highway development.

It is interesting to compare this total with the sums invested annually by the government through the Ministry of Fomento alone. Those of 1937 represented a four-fold gain over 1936, and ten-fold over 1932, as may be seen in the following approximate totals, which prior to 1937 did not include certain sums spent on roads by the pro-unemployed and other commissions:

Year	*Soles*
1932	1,900,000
1933	3,000,000
1934	3,600,000
1935	4,000,000
1936	4,700,000
1937	20,000,000

The 19,000 kilometers of highway which existed in Perú in 1932 for the most part closely resembled the winding, narrow, dusty, rough and dangerous roads of the most rugged territory in the United States twenty to thirty years ago. As a matter of fact, the 39-kilometer two-line concrete road from Lima to Chosica, inaugurated in 1931, was the first real highway of consideration extending beyond the immediate area of the larger cities. A total of around 260 kilometers of good roads was built in 1932, at a cost of S/1,900,000. Since that time progress has been systematic, as shown by the following totals of new highway construction during the fiscal years ended October 3, from 1933 to 1937, inclusive: 452, 488, 520, 606, and 734 kilometers. But properly speaking, first-class, long distance, interurban highway construction dates from the inauguration of the Lima-Chosica-Oroya Central Highway in 1935; and the highway year ended October 3, 1937, was the first of important in comprehensive, modern surfacing. Combined asphalted sections up to October of 1936 totaled 124 kilometers, while during the year ended in October of 1937, 267 kilometers were so surfaced.

American Paver Used as Asphalt Mixer at Work on the Lima-Cañete Highway.

*1 sole = $0.22 North American money. [Ed.]

The Central Highway Above Chosica, Showing Appearance of the Road as Completed.

Road Mileage by Construction Types. — Perú's highway system in October of 1937, classed by types of surface, was as follows:

	Kilometers
Unimproved earth	3,922
Improved earth	4,700
Crushed stone	9,177
Waterbound macadam	3,533
Cement-concrete	94
Reinforced concrete	24
Concrete and asphalt	14
Macadam and asphalt	377
Total	21,843

The three-year proposal embraces 5,790 kilometers of reconstruction and improvement, 2,044 kilometers of new construction, and 1,034 kilometers of asphalt surface, making a total of 8,868 kilometers, or 5,510 miles. Progress during the year ending in October, 1937, is detailed as follows:

	Kilometers	*Miles*
New construction	734	456
Reconstruction	78	48
Asphalting	267	166
Improvement	1,500	932
Total	2,579	1,602

When the road between Abancay and Ayacucho is completed, and the contemplated system of State-operated inns is put into operation, the only drive worthy of the designation "sky-line," 1,655 kilometers (1,028 miles) in

The Sullana Bridge, One of the Largest in Perú, 300 Meters Long and 5 Meters Wide. Cost S/500,000. German Steel.

Complete Equipment

for Unloading Storage Batching Handling

Hundreds of successful installations of Portable Bulk Cement Plants for road construction provide the experience which Blaw-Knox will build into a plant for you.

Your plant will be designed for rapid and low cost erection, dismantling and moving. It will be low in operating costs and maintenance, and it will include the following equipment:

STEEL STORAGE BIN (portable)—Weathertight and moisture proof.

WEIGHING BATCHER—Manual or automatic operation. Equipped with no-jam, leakproof gates. Either beam type or springless dial scales.

CONVEYING EQUIPMENT for elevating cement into storage bin with necessary unloading equipment for receiving cement in hopper bottom cars, box cars or truck delivery.

POWER UNIT and drive for the conveying equipment, either gas or electric powered.

CEMENT BAGS for handling bulk cement in compartment trucks.

Blaw-Knox Bulk Cement Plants represent the ultimate in portability, speed, and convenience of use and operation. They are completely described in Blaw-Knox Catalog No. 1566, a copy of which will be sent to you upon request.

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Bulk Cement Bag
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length from Desaguadero, on the Bolivian boundary, by Lake Titicaca, northward to Puno, Cuzco, Ayacucho, Huancayo, Oroya, and Cerro de Pasco, ranging from 10,000 to 14,000 feet in altitude, with major ups and downs crossing the Apurimac basin between Cuzco and Huancayo, will be open to the world's tourists who seek the absolutely new in travel, and the utterly different.

Maps and reports by trained North Americans and Perúvians do not record what was written in 1757 by the "Padre Franciscano Abad," in Volume II, of "Misiones Franciscanas"—a pass of low elevation between the upper Tulumayo basin and the Pampas del Sacramento. Three young Perúvian engineers, following the general instructions of their superiors, in July of 1937 found Padre Abad's pass; and their photographs together with aerial photos made in confirmation of the survey by land, portray the canyon and the Pampas del Sacramento, through which the Pucallpa highway will pass; and which, so far as the records show, no white man has seen since 1757. The new route will shorten the distance between Tingo Maria and Pucallpa by some 90 kilometers, reduce the grades over the third range, and effect an economy of several million soles. Americans,

An American Tractor Widening the Embankment on the Huanuco-Tingo Maria Section of the Pucallpa Road.

particularly the manufacturers and laborers back in Detroit, Peoria, Marion, and other centers will be proud to know that the Perúvian government has chosen their road building equipment for use in opening this vast realm which soon will be offering new products in reciprocation.

The northern coastal highway from Lima through Huacho, Casma, Trujillo, Chiclayo, Piura, and Tumbes to Huaquillas on the Ecuadorean boundary, a distance of 1,545 kilometers (960 miles), is passable by motor vehicles, but much work remains to be done, and the appropriations have not been as great as those for the central and southern regions. More emphasis will be placed on them during 1938 and 1939.

Widening, straightening, new construction, asphalting, etc., will be pushed under the three year program until all of the principal coastal and interior towns are linked by highways affording safe and fast transportation.

Roadbuilding Equipment Quadrupled in Twelve Months.—Owing to the abundance of cheap labor and also to the government's policy of using hand labor as much as possible in order to assuage unemployment, the market for road making and construction machinery and equipment is not as great, proportionally, as in the United States. The principal method of earth moving, for instance, is by pick, shovel, wheelbarrow, or truck. As a rule the departmental supervisors contract with a local labor boss for opening or grading a certain section, either by lineal distance or by cubic meter. The local contractor in turn hires the laborers directly. This system is followed also by industrial organizations. In one known instance, a leading mining company has entered into such a contract for shoveling and wheeling gravel into railway cars, while a steam shovel stands idly by. The hand-labor contract method is cheaper, although slower.

Nevertheless, about S/2,000,000, or 10% of the appropriation for the year, were dedicated to the acquisition of road-building machinery and equipment, and in less than one year the government has purchased four times the number of serviceable machines on hand at the end of 1936; and American makes were chosen in heavy proportions, according to the following data obtained from authoritative sources:

	In use at the end of 1936	*Purchased Jan.-Nov., 1937*	*Total*
*Trucks and automobiles	94	290	384
Road rollers	15	47	62
*Road graders	4	26	30
*Trailbuilders	..	30	30
*Tractors	..	26	26
Concrete and asphalt mixers	10	13	23
*Asphalt heaters	..	34	34
*Rock crushers	4	12	16
*Scrapers and scarifiers	4	24	28
*Centrifugal pumps	6	20	26
Total number of units	137	522	659

Owing to group classifications, it is impossible to present customs statistics showing imports by classes, countries of origin, and value. However, United States exports to Perú during the first nine months of 1937 supply certain additional details:

	Number of units	*Value in Dollars*
Road rollers	34	62,338
Road graders	41	42,200
Concrete mixers	29	21,000
Excavator parts and accessories	..	4,524
Other road-making equipment and parts	..	28,535

Some of this machinery was for private organizations or other services of the government.

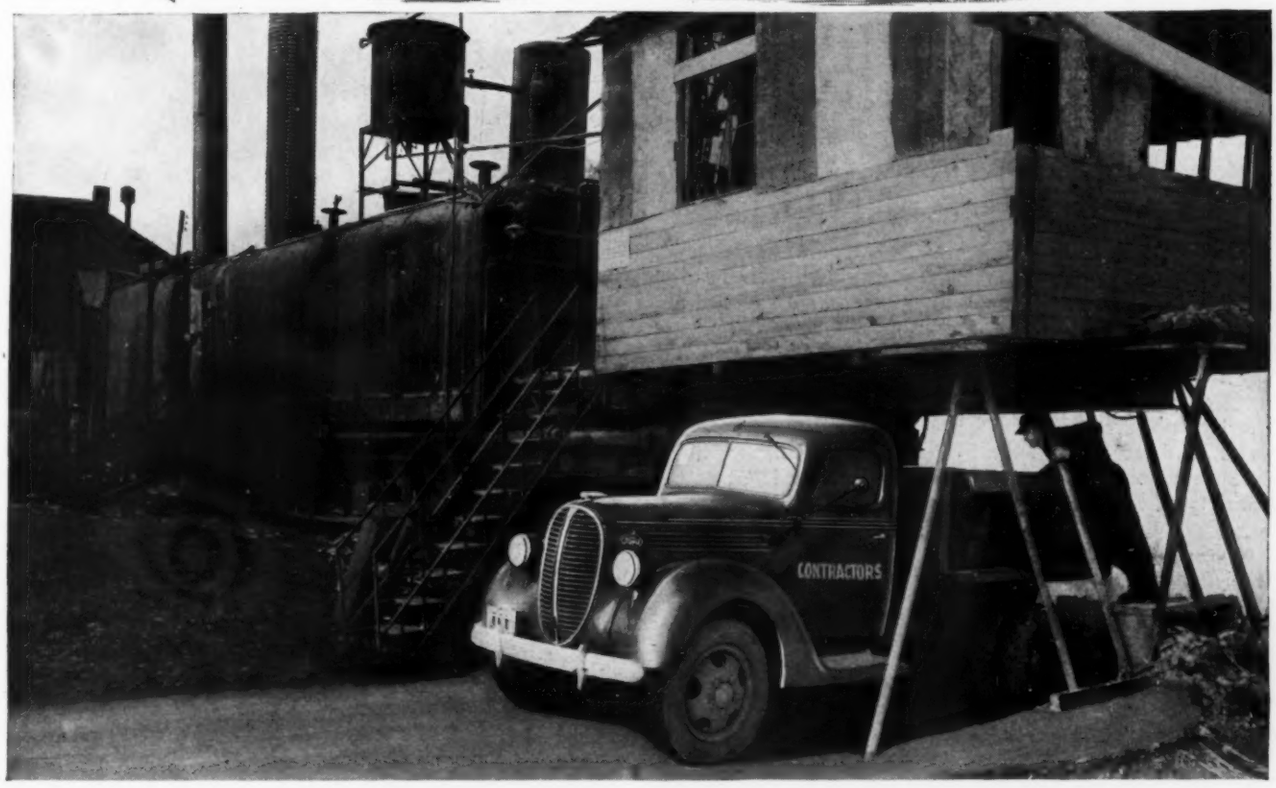
Road machinery and equipment is dutiable at S/0.04 per kilogram gross weight, but there are numerous additional charges and surcharges which total about 30% of the import duty. There is no domestic manufacturing.

1938 Outlook Favorable. — According to current plans, expenditures on highways during the second year of the program will total S/24,000,000. While it is not expected that acquisitions of new equipment will attain the proportions of the initial year, it is probable that additional or supplemental units will be needed. But with a perfected organization and trained personnel, more rapid progress in the extension of roads appears certain. More intensive use of motor vehicles, by tourists, farmers, mining companies, and manufacturers, is in the immediate prospect.

Highway Administration. — Under the present highway expansion and improvement plan practically all activity relating to motor vehicle routes is centered in the Ministry of Fomento. The incumbent Minister is Mr. Hector Boza. The Dirección de Obras Públicas y Vías de Comunicación, of which Mr. Federico Basadre

*Indicates that all of the equipment is of American manufacture. Among the road rollers and mixers, American marks predominate.

MORE PAY IN EVERY PAYLOAD FOR CONTRACTORS



1938 Ford V-8 Trucks and Commercial Cars have been built to do more work, in less time, at lower cost. Time-proved features, including the famous Ford V-8 engine and the 1938 improvements and refinements, put more pay in every payload.

The Ford V-8 engine is speeding up work for many companies—it continues to roll up new records for performance and economy. The 85-horsepower Ford V-8 Truck engine powers the new 134-inch and 157-inch wheelbase trucks. A choice of either the "85" or "60" V-8 engine is offered in the new 122-inch wheelbase one-ton trucks and the 112-inch wheelbase commercial cars.

The Ford Engine and Parts Exchange Plan is another reason why owners find Ford units profitable and economical to operate. When an overhaul does become necessary, this plan saves time and money—keeps units on the job.

The nearest Ford dealer will lend you a 1938 Ford V-8 Truck or Commercial Car without charge or obligation to make an "on-the-job" test with your own loads and your own driver.

FORD V-8 TRUCKS
AND COMMERCIAL CARS

The Pampas del Sacramento, Lying Between Pucallpa and Tingo Maria, Through Which the Pucallpa Road Will Pass. As Far as Is Known, This Forest Region Has Not Been Explored by White Men.

is Director, is in immediate charge of purchasing, planning, construction, repairing, and general administration. There are several subsections dealing with specialized matters. The departmental pro-unemployed and other commissions, more important in past years, still exist; but it is stated that their activities under the three-year-plan will be negligible. Law No. 8522, of April 2, 1937, created an Economic Highway Committee in which important powers of authorization and vigilance are vested. The Minister of Fomento is President, and the members are the Director of Public Works, the President of the Society of Engineers, an army colonel, and an independ-

The Newly-discovered Pass, Presumably the One Mentioned by Padre Abad in the Year 1757.

ent engineer designated by the President of the Republic. As usual, the larger mining, agricultural, railway, and other commercial or industrial organizations build roads on a relatively small scale compared with State construction projects.

American manufacturers desiring to participate in the business, or to increase their share in the road equipment trade of Perú should maintain efficient representation in the local market, as an essential requirement. Not only is a representative indispensable for successful bidding, but also to provide prompt service in the case of replacements and technical assistance. Competitive prices, satisfactory credit terms, and descriptive literature in the Spanish language constitute other advantageous sales arguments.

Sources.—Minister of Fomento Hector Boza; former Minister Federico Recavarren; Director of Public Works Federico Basadre; Engineer Enrique Pimentel, in charge of the Huanuco-Pucallpa road; official maps; personal observations while motoring; the office files.

All photographs were supplied by the Director Obras Publicas, Lima. [Ed.]

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Helm Elected President of Asphalt Institute

At their annual meeting the Board of Directors for the Asphalt Institute elected Joseph S. Helm of the Standard Oil Co. of New Jersey President for the fiscal year, beginning April 1, 1938.

President Helm announced that in spite of the depression the consumption of asphalt for 1937 had exceeded 1936 by 1 per cent reaching an all-time high 17 per cent above the pre-depression 1929 level. This record he ascribed largely to the remarkable development of the "Farm-to-Market" road program.

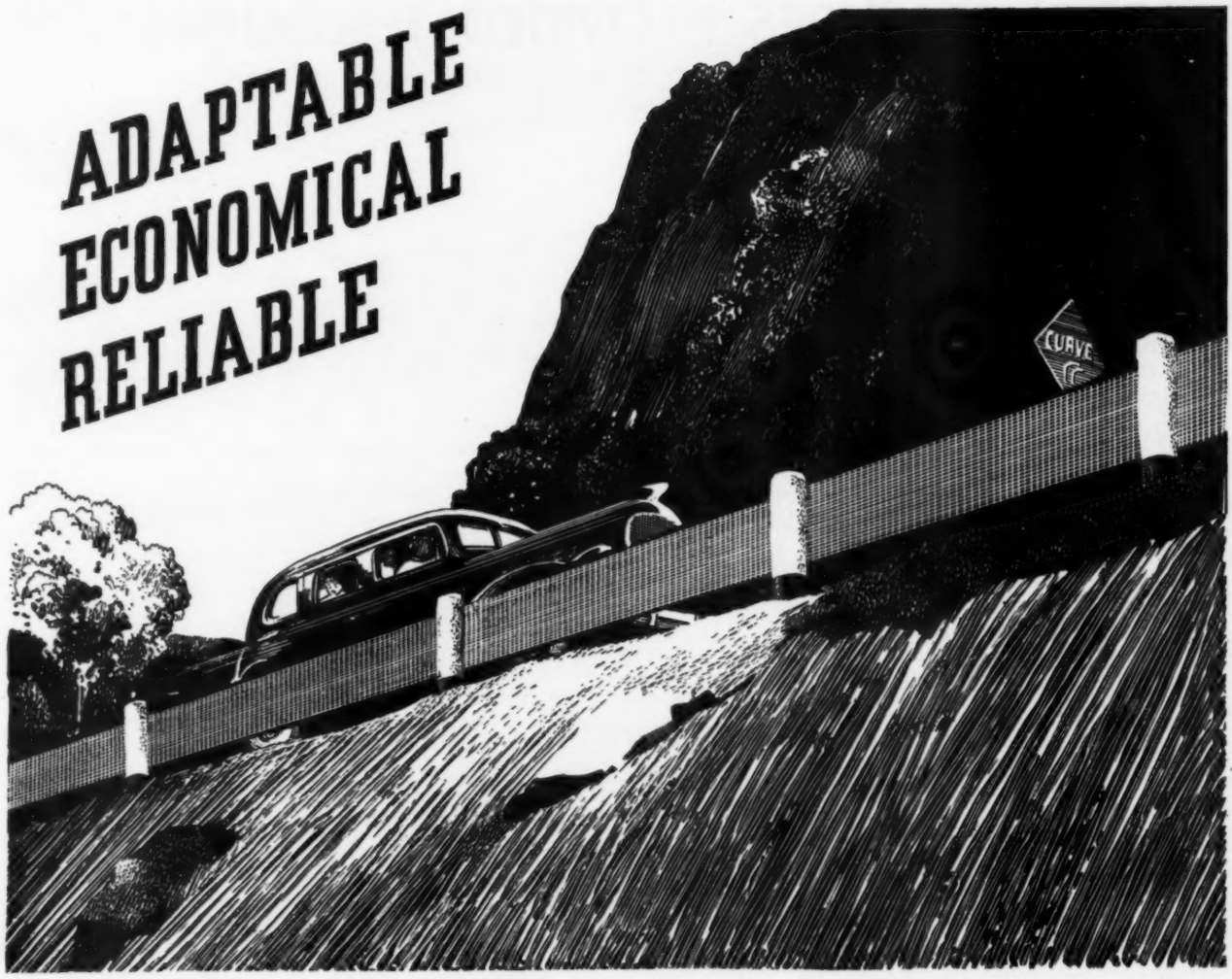
Striking progress in the development of low-cost housing through the use of asphalt in combination with sand and clay to form walls, floors and blocks, was shown in a special exhibit at the meeting.

B. L. Boye of Socony-Vacuum retiring president, was made chairman of the Executive Committee of the Institute. Other officers elected were James A. Blood (Standard Oil Company of California) Vice President; T. M. Martin (Lion Oil Refining Company), Vice President; A. M. Maxwell (Standard Oil of Ohio), Vice President; Herbert Spencer (Standard Oil of New Jersey), Treasurer; F. V. Widger (The Texas Company), Secretary; with an Executive Committee of Messrs. Boye, Blood, Helm, Martin and David Waxman (Shell Petroleum Corporation). J. E. Pennybacker continues as Managing Director of the Asphalt Institute.

Spirited competition between a number of cities, with Miami and Los Angeles in the lead, marked the consideration of the place for holding the National Asphalt Conference (usually held in December). The matter was laid over for discussion at a later meeting.

Joseph S. Helm, the new president of Asphalt Institute, was born near Lexington, Ky., and was educated at the University of Kentucky in that city. After graduation he became associated with the Chesapeake & Ohio Railroad, in the Engineering Department. Experience in railroad construction and replacement of roads qualified him in later years for the marketing of asphalts with the Standard Oil Co. of New Jersey and associated companies both at home and abroad. In his many years of Standard Oil association, he has developed a world-wide acquaintance in the road building industry. He was one of the original organizers of The Asphalt Association (now Asphalt Institute) in 1918, and has been a Director since its organization, also a former president. On his return from Europe in 1926, where he installed an Asphalt Marketing Department for the New Jersey associated companies, he was made Manager of the Asphalt Department of the Standard Oil Co. of New Jersey, handling world-wide asphalt matters. His office is located at 26 Broadway, New York, and his residence is in Bronxville, N. Y.

ADAPTABLE ECONOMICAL RELIABLE



Regardless of grade, curve, rise or dip or any combination of these conditions "Pittsburgh" Safety Highway Guard, *without special fittings,* is as readily adaptable as cable to any road. This high tensile wire band is easily and economically installed because exact post spacing is not required. Maintenance is low because repairs and adjustments are made on the spot by unskilled labor.

Capable of standing a total load of more than 45 tons, "Pittsburgh" Guard gives sure protection to vehicles. Further, its resiliency provides a "cushioning" action under impact which results in shunting the vehicle along the guard, thus minimizing damage to both. Write for the summary of the Pittsburgh Testing Laboratory study of "Pittsburgh" Guard under actual traffic conditions.

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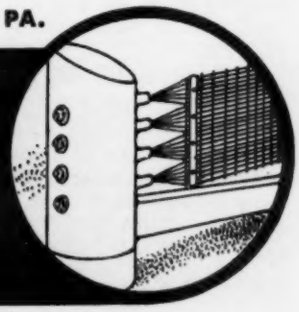
Safety **HIGHWAY GUARD**



SAFETY FEATURES PROVIDED THROUGH PAVEMENT MARKINGS

By R. M. REINDOLLAR

Assistant Chief Engineer,
Maryland State Roads Commission

MARYLAND is confronted with the problem of making her highways as safe and as usable as possible until such time as funds are available for the rebuilding of her primary system in accordance with modern standards of highway construction.

To this end, several years ago, reflector-type symbol warning signs which depict the condition of the road ahead, were erected, thereby giving the motorist advance information as to the nature of curves and hazards and when approaching highway intersections. (Compliments to Maryland on those reflected signs.—Ed.) In addition to this, a white surface stripe was painted along the center-line of the highways at locations of both vertical and horizontal curvature, and also at highway intersections, where the sight distance was not adequate for one motorist to pass another going in the same direction, with the proper factor of safety, to control the movement of traffic and keep vehicles in their proper lanes. In the Spring of 1937, continuous center-line striping was adopted for all of our main highways.

Under this new method of center-line marking, on two lane roads, a continuous yellow stripe, 6 in. in width is marked on the center-line of the pavement, and at points where vertical and horizontal curvature, or where obstructions along the right of way, are such that they preclude a 500-ft. sight distance; a white stripe 3 in. in width is placed adjacent to the center-line stripe indicating "no passing" zones. The white stripe is placed on the side of the center-line in which traffic is to be confined in one direction and is discontinued at the point where vision is clear ahead and it is proper for a motorist to pass provided the lane in the opposing direction is not occupied by a vehicle. In all cases, however, a minimum of 200 ft. of completely restricted zone is established. This method of striping permits the maximum use of the highways in that the restricted zones are directional and the motorist can always cross the center-line where adequate sight distance prevails.

On the 3-lane roads, a sight distance of 1,000 ft. has been established by special surface marking confining traffic to a single lane in crossing the brow of a hill or in going around curves where such a sight distance is not obtainable through road design. The right of way on the center-line is in every instance provided so that cars traveling at high speeds can pass the slower moving vehicles on ascending grades. On 3-lane roads, this striping is supplemented by "Keep to Right" signs placed along the edge of the right of way and also surface marking indicating to the motorist the points where he must work his way into the outside lane before reaching the area restricted to a single lane in his direction of travel.

In addition to this center-line striping, other provisions for surface marking in use in Maryland as safety features include school zones and railroad crossings supplementing signs at these zones, and also "Slow" and "Stop" indications supplementing signs at primary boulevard intersections.

In the painting of center-line stripes, we have developed a machine which will do the surface marking at a minimum cost. Two machines have been developed by mechanics in the employ of the State Roads Commission, and we believe the last one which has just been completed is worthy of your consideration.

The line laying device is an especially designed unit. It is so assembled that at will you can lay a 6-in. yellow or white line, or a 3-in. white line on either side of the yellow line, or a solid 12-in. white line. This device is hinged on a hangar extended from the chassis frame on the left side and follows the line of wheel travel, so that when sighting from the driver's seat, keeping the left front wheel in the center of the road, the line will also be in the center. Specially heat treated sawsteel discs confine the paint and last about 18 months in constant service.

The paint is supplied to this device through pipe and hose connection to the rear end of the chassis. An especially designed nozzle is attached in a fixed position about 4 inches from the road suspended between discs properly spaced to give the desired line width. Each nozzle is individually controlled by the operator in a position to the rear of the device to permit ease of operation. The operator, in addition to regulating the application of paint, places Z-shaped plates on the newly painted line to keep motorists from driving over it before it dries.

The new unit which has just been completed, applies the paint through air-pressure. The paint is contained in a tank designed and constructed to meet our requirements by Gar Wood Industries, Incorporated. It has three compartments, one of 450-gal. capacity for yellow paint, one of 275-gal. capacity for white paint, and the other of 75-gal. capacity for thinner. This tank is ellipse-shaped with air-tight manholes on the two larger compartments. Agitators of a demountable type, driven at approximately 100 r.p.m. by power through a line shaft connected to a power take-off, are mounted in these two compartments. There is also a 1½-in. Viking rotary pump driven from the line shaft through which the paint is loaded into the tank. By this method of loading, both compartments, with a total capacity of 725 gal., the paint being delivered in 50-gal. drums, can be filled in less than one hour.

The tank is so constructed as to give uniform distribution of weight on a 1937 Model LH-47 Dodge chassis. It is capable of any pressure desired to give best results depending on viscosity of paint being used. It is equipped with dual safety valves, pressure regulating valve and pressure gauge on the two larger compartments, which can be controlled separately.

The air is supplied by a 12-cu. ft. Westinghouse air compressor, mounted on and driven by the truck engine. The compressor is lubricated by force feed pressure from the engine to insure lubrication. It is also water cooled, being connected with the engine cooling system. The air supply is stored in a 32-gal. capacity steel tank mounted on the left side of the chassis. This tank is equipped with a 150-lb. safety valve and pressure gauge. The air is piped from the storage tank to the paint tanks which operate at a top pressure of 65 lb.

The paint is forced under pressure to the nozzle and then atomized by an especially designed air induction

POUNDING ALONG

BUT TRINIDAD CAN TAKE IT!

East Fayette Street, Baltimore, Md., topped with 7000 square yards of Trinidad Sheet Asphalt.

Heavy motor-freight traffic is a sign of good business. It also shows the need for top-quality pavements. And Barber invites highway engineers and others interested in low-cost-per-square-yard-per-year paving, to study the many advantages of Trinidad Lake Asphalt.

Trinidad Lake Asphalt is a native asphalt "mined" from the famous asphalt lake on the southern Caribbean Island of Trinidad. It has already withstood centuries of exposure to a year-round summer sun, the fury of countless tropical tempests. Today—because of its ductility—it has the resiliency to withstand the shocks of heavy traffic, even at low temperatures. It contains a colloidally dispersed wear-resistant mineral filler which has not yet been duplicated in any commercial asphalt. It is uniform in quality.

Trinidad Native Lake Asphalt pavements are ideal for today's exacting traffic conditions. Clip and mail the coupon below, pinned to your letterhead, for full and complete information.

TRINIDAD NATIVE LAKE ASPHALT

THE BARBER COMPANY, Inc., Dept. RS-4, 1600 Arch Street, Philadelphia, Pa.
Please send me complete information about the Barber Products checked below.

- ☐ **TRINIDAD LAKE ASPHALT** — For hot mix, for cold-lay sheet asphalt and asphaltic concrete pavements.
- ☐ **BARBER EMULSIFIED ASPHALTS** — Used cold for penetration, pre-mix, road mix (mixed in place) and surface treatment work.
- ☐ **GENASCO CRACK FILLER** — For maintenance of concrete roads.
- ☐ **BARBER BRAND LIQUID ASPHALTS** — For cold surface treatment — for hot surface treatment.
- ☐ **BARBER BRAND WINTER COLD PATCH** — A cut-back asphalt for use in patching and maintenance work in cold weather.
- ☐ **GENASCO BLOCK AND JOINT FILLER** — For brick and granite block streets.

under 15-lb. pressure at the nozzle through a sixty-thousandths orifice stand pipe in the nozzle stand pipe. The operator will be seated on the rear end of the chassis to operate the lining device.

The truck is equipped with a 5-speed transmission and 2-speed axle giving 10 forward speeds, which permits proper operation under all conditions. Paint is applied with the unit moving approximately 9 miles per hour.

It is believed that with this new machine, we will have no difficulty in painting approximately 40 miles of road in an 8-hour day, as 20 miles of road can be painted with each filling. We have been using approximately 27 gal. of yellow paint for one mile of continuous 6-in. line and approximately 25 gal. of white paint for one mile of continuous 6-in. line. Under our method of striping, a total of approximately 40 gal. of paint is consumed per mile. With the new machine, we expect to reduce the amount of paint consumed to from 30 gal. to 35 gal. per mile.

A service truck is used in connection with the paint truck to reclaim the plates which are dropped on the newly painted line to keep traffic from driving over it until it dries. These blocks are picked up by a man suspended on a spring seat in the rear who reclaims them while the truck is moving at 20 miles per hour.

The cost of operation and depreciation of the two trucks, plus a four-man crew, including their board, is approximately $50.00 per day which makes the actual cost of all operations in connection with the painting of the lines on the surface with the small outfit, exclusive, of course, of the cost of the paint, approximately $3.00 per mile, and with the larger outfit, this will be reduced to less than half of this amount.

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Progress in Studies on Soils for Engineering Purposes

Reports presented by the 11 subcommittees of the A. S. T. M. Committee D-18 on Soils for Engineering Purposes indicate that definite progress is being made.

The subcommittee on stabilization, divided into groups according to the interest in various methods for stabilizing soils, has been studying the applicability of the generally accepted methods of tests of soils to the particular methods of stabilization. The portland cement group reported that four of the tests being considered are applicable to the study of soils stabilized with portland cement. These tests are for moisture density, freezing and thawing, wetting and drying, and shrinkage and swell. It is expected these test methods will be given consideration by the general committee, and at least presented as information, at an early date.

The calcium chloride group reported that the method of test for determination of percentage of voids and density, were the only methods of tests of those submitted for consideration which were applicable to the study of stabilization of natural soils with calcium chloride.

A method of test for determining shear of soils in service in roads is being developed and the results obtained to date indicate the method may present valuable data in regard to calcium chloride and soil bound mixtures.

The subcommittee on compressibility and elasticity of soils presented a particularly satisfactory report on the correlation of the various methods of making tests on compressibility of soils, with the purpose of developing a standard method.

Careful study has been made of the present standard method of tests of soils for engineering purposes and some recommendations for revisions to bring these methods up to date have been submitted to the general committee.

The officers of Committee D-18 are—Chairman: H. F. Clemmer, Engineer of Materials, Engineering Dept., District of Columbia; Secretary: W. R. Nelson, U. S. Bureau of Reclamation, Washington, D. C.

▼

Portable Concrete Road Signs

Concrete road sign and mail box posts, that can be moved either to meet changing road conditions or while the right of way is being moved, are now being used by the Arkansas Highway Department.

Portable Concrete Road Sign

The sign posts are 5 ft. 5⅝ in. high overall and are composed of a 3⅝-in. square post set on an octagonal base 1 ft. 8 in. in diameter and 3⅝ in. thick. Four ½-in. reinforcing rods run the full length of the post and are tied to short rods placed at the quarter points of the base. Signs are attached by bolting them through two ½-in. holes on 2-ft. centers formed in the posts when they were cast.

The mail box posts have the same type of base as the sign posts, but are only 4 ft. 1 in. high overall and have only two reinforcing rods in the column. Support for the mail boxes is provided by flaring the top of the post to 1 ft. 5 in. and capping them with a 1⅝-in. wooden strip which is held down by two ⅜ x 3-in. machine bolts embedded in the concrete.

During 1937 a total of more than 1,000 posts of both types were made and distributed by the National Youth Administration shop at Dardanelle. Materials for the manufacture of the post were supplied by the Highway Department, co-sponsor of the project.

NU-ARCH CULVERT

GRANITE CITY *Laboratory* CONTROL

...adds years of life to culvert stock!

You can be confident your culverts will last longer when they are made of Granite City Culvert Stock. Years ago, Granite City engineers developed a system of exacting laboratory and mill checkups which assure *unusual uniformity* of base metal and spelter coating. This constant checking of every phase of Granite City's special processing results in Culvert Stock with exceptionally *long life* and resistance to corrosion.

Specify one of these Granite City base metals on your next culvert job: Granite City Copper Iron, Copper Steel, or Pure Iron. Each is certified *in writing* as to base metal and spelter weight.

GRANITE CITY STEEL CO., Granite City, Ill.

For positive assurance of long culvert life...specify

Granite City Certified Analysis Culvert Stock.

A Stabilized Base Job in Michigan

EXTENSIVE improvements are in progress on U. S. Highway No. 10 in Michigan. One of the many projects is black-topping of about 12 miles extending from a point close to Baldwin, then westward to the village of Custer. The base course on which the black top is being laid, is clay stabilized gravel.

On this job the gravel was pit run material put through a crushing and screening plant, 100 per cent passing ¾ in. square mesh screen. The clay content was 12 to 15 per cent by weight. The calcium chloride content was 6 to 10 lb. per cubic yard of stabilized material. Water content was 6 per cent by weight minimum.

Marsman & Taber of Grand Rapids, Mich., the contractors who furnished the material and laid the base course for this black topping job, prepared the stabilized gravel with their recently purchased stabilizing plant, which is a product of the Pioneer Engineering Works, Inc., of Minneapolis, Minn.

The stabilizer plant, together with their crushing and screening plant, were set up in a gravel pit one mile northeast of Branch, Mich., being approximately midway between the extreme ends of the job.

The clay was obtained about two miles from the gravel pit. It was hauled by trucks and stockpiled by dumping over the edge of an unused portion of the gravel pit.

The pit run gravel, crushed to size, was delivered directly into the receiving end of the pugmill of the stabilizer plant from the crushing plant. Uniformity of flow of gravel was obtained by a mechanical feeder which fed a pre-determined amount into the crushing plant.

The clay, which was stockpiled nearby, was delivered into the hopper of the clay feeder by a dragline. The clay feeder delivers a pre-determined amount of clay onto the clay belt conveyor—in this case about 12 cu. yd. per hour—from which it goes into the clay shredder which surmounts the receiving end of the pugmill.

On the operator's platform surmounting the clay shredder is located the calcium chloride feeder, which measures and delivers a pre-determined amount of calcium chloride into the receiving end of the pugmill. The calcium chloride, which was handled in sacks, was conveyed by the clay belt conveyor up to the operator's platform, where it was stored and dumped into the calcium chloride feeder hopper as needed. Conveying of the calcium chloride sacks in no way interferes with the continued operation of the plant.

Water was delivered to the plant by a force pump supplied by three shallow driven wells. Since the force pump was directly connected to the water system of the stabilizing plant in this case, an overflow for excess water and to maintain uniform pressure was provided. The stabilizing plant, however, is equipped with a centrifugal pump and water piping system so that the correct amount of water, needed for proper mixing and blending of the ingredients, is regulated on the operator's platform. (Ordinarily water is taken from a supply tank on the ground close to the stabilizing plant.)

The average rate of production was about 90 cu. yd. of stabilized material per hour. The finished product was conveyed into a storage bin from which it was loaded into trucks—most of it being hauled directly to the grade, while a small portion was stockpiled close to the plant.

On the grade the base course of stabilized gravel was spread 3-5 in. in thickness by a blade grader and compacted by the trucks and road rollers.

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London By-Pass

According to Roads and Road Construction, London, the average time taken to travel the length of the North Circular Road around London is approximately the same as required to travel between the terminal points by a route through the center of the city. The average speed on the circular route, 23 miles long, was 23½ miles per hour; on the direct route (12½ miles long) it was 12½ miles per hour.

The slow average maintained on the Circular Road indicates that modern by-passes cannot fulfill their proper function unless designed as "express highways." If ribbon development had been prevented 20 years earlier, delays and congestion would be less. Higher speeds are now dependent upon separation of traffic lanes and the redesign of intersections.

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TEXAS TAKINGS BID FOR STRIPING HIGHWAYS.—The State Highway Department of Texas, Austin, Tex., will open bids April 14 for painting traffic stripes on 1,097 miles of highway. The time for completion of the work is 55 days.

A Stabilizer Plant Set Up on a Michigan Road Job. Included Al so in This Setup Is a Crushing Plant. This outfit Is Owned by Pickett & Goodwin, Con tractors, Allegan, Mich.

IN MICHIGAN – HERE'S HOW –

–They Produce **STABILIZED** *Road Material*

GRAVEL is screened, oversize crushed and re-screened in the Pioneer 38-V Duplex, Crushing, Screening and Loading Plant (shown in background). The Delivery Conveyor of the gravel plant delivers the sized gravel directly into the pugmill of the Stabilizer Plant (shown in center of picture).

CLAY is brought to the trap, (lower right) measured in the clay feeder under the trap, conveyed to the Stabilizer Plant, pulverized in the clay shredder and deposited in the pugmill.

CALCIUM CHLORIDE in sacks, is carried up the clay feeder conveyor to the platform, dumped into the Calcium Chloride hopper, measured and fed to the pugmill.

WATER is pumped from the storage tank and added to the materials in the pugmill.

THE STABILIZED MATERIAL is thoroughly mixed in the pugmill and the finished product is delivered to the storage bin (left), trucked to the road, dumped, spread, and rolled.

The result is an economical all-weather road that is hard, dustless, free from ruts and loose material, and which requires little maintenance. In addition, such a road makes an ideal base course for a higher type surface at some later date.

THE PIONEER PORTABLE STABILIZER PLANT will produce better stabilized roads because of the accurate measure of the ingredients — complete shredding of the clay — and the thorough mixing of the finished product.

THE PIONEER PORTABLE STABILIZER PLANT will build cheaper stabilized roads because it requires less equipment, eliminates delays from weather conditions and reduces risk from equipment on the road.

Write today for your copy of our booklet "Stabilized Roads — Principles, Design and Construction".

PIONEER ENGINEERING WORKS
MINNEAPOLIS, MINNESOTA
FORMERLY PIONEER GRAVEL EQUIPMENT MANUFACTURING CO.

PIONEER

MANUFACTURERS OF QUARRY, GRAVEL AND MINING EQUIPMENT

EDITORIAL

Do Your Part

DURING the hearings on H.R. 8838 before the House Roads Committee, a statement was made to this effect:

> The amounts for 1940 federal aid could be materially reduced without any serious effects upon the high way program nationally. This refers to 1940 funds only; the 1939 and 1941 federal aid should remain at the present level. By way of explanation of this statement, the point was stressed that this condition was so because of the large accumulation of federal funds which have so far not been matched by the states. It was anticipated that the states could take up this back-log by the end of 1941, and then proceed on a continuing program based on present authorizations.

The cause of this, of course, is diversion. The American Road Builders' Association is doing an active job in campaigning against diversion. They cannot do the job alone. The publishers and editors serving the highway field, as well as other editors and publishers, are devoting their efforts and publication space toward the fight against diversion of gas tax and motor vehicle funds to other purposes than highways. They cannot do the job alone, either.

The diversion fight hinges on your individual effort, Mr. Contractor, Mr. Equipment Dealer, Mr. Engineer, right in your own back yard and at your own home. It is up to you, individually, to write letters to your representatives in your state legislatures. It is up to you, individually, to write letters to your local newspaper editors. It is up to you, individually, to talk with your legislators and business leaders.

We can, do, and shall continue to, furnish you with facts, arguments and data. Use it!

Sit down at home tonight and write some letters.

You leave the job to an hypothetical "They," thinking that highway funds will continue without break. You assume the, "Let George do it" attitude. Of course, your dues and subscriptions help; but you must be active, individually. Do your part and we'll stop the diversion menace.

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On Good and Bad Driving

WHEN I drive a motor car, said Socrates, I endeavor to meet three requirements—to drive safely, to drive in lawful manner, and to drive courteously. And of these requirements, the first and most important is the easiest, although certain cynics would have us believe that the good things and the important are always the most difficult.

That safety should be first seems to me self-evident; but if you doubt it, consider that safety embraces at once the primary intent (if not always the letter) of the law and also the fundamentals of courtesy, although in emergencies the fundamental may require the violation of a minor rule.

As to the ease of safe driving, you may note that no one drives dangerously except through thoughtlessness or excitement or disregard of another's right. But the thought required for driving involves no deep or complicated reasoning: rather is it primarily a matter of attention, with due regard to one's own abilities and the powers of his machine. Therefore, it is not difficult, though often neglected. And he who drives his car always thus thoughtfully will seldom have cause for excitement which drives thought from his brain; or if he does have such cause, he will rise above it and drive well in spite of it. And he who endangers others through violation of rights does so not because safety is difficult but through wantonness.

To drive lawfully requires greater patience and tolerance than to drive safely, for while the importance of safety is obvious, many driving rules are not so and are therefore hard to obey. Nevertheless, we ought to obey them in spirit, and where possible, in letter.

In and around certain cities, it is a general custom to exceed posted speed limits by from 5 to 15 miles per hour; and what is a virtuous driver to do in such a case? Shall he adhere to these limits, thereby making himself a nuisance, or shall he conform to custom in so far as he is safely able? Clearly, it seems to me, the latter; for in reality, custom is more nearly law than is any printed word. But that such conditions are evil cannot be denied; for either the posted limits are truly the maximum consistent with safety, and therefore should be enforced by officers and courts until conformity to them is general, or else they are unreasonably low and should be increased accordingly.

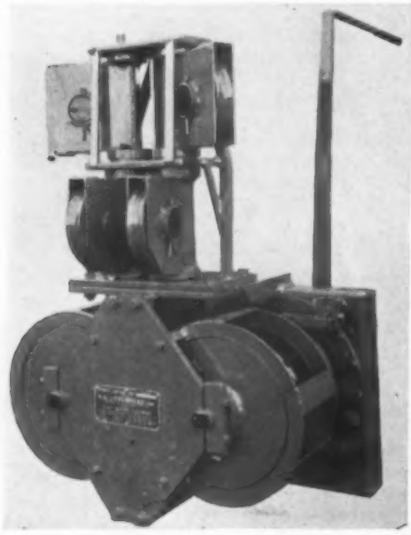
But what of the twenty-miles-per-hour sign which you encounter where you can neither see necessity nor yet observe that traffic consistently exceeds it? In such cases, I say, obey the sign, for there may be ample reasons which you can neither know nor judge without careful study. And even if you do judge it to be unreasonable, remember that it is your judgment against the judgment of one who presumably has given the matter more attention than you, and furthermore, who has the better right to decide.

Now only a superior person will observe true courtesy on the road; for between the thoughtless driver on the one hand and the arrogant on the other, you are subjected to such continuous irritations, that ultimately you give up trying to do as you would be done by and descend to the tactics of the arrogant, although in so doing, you know in your heart that you are exhibiting weakness rather than strength, and are committing acts which in others you despise.

NEW EQUIPMENT AND MATERIALS

New Power Control Unit

Designed for extreme ruggedness and for fool-proof, efficient operation of cable controlled heavy grading equipment, a new double-drum power control unit has been placed on the market by R. G. Le Tourneau, Inc., Peoria, Ill., and Stockton, Cal. The new unit, designated as Model R8 and for use on "Caterpillar" D8 tractors, incorporates a number of improved features over the Le Tourneau type "N" power control unit. The gear reduction ratio has been lowered; thus line speed is reduced, and line pull (with empty drum) is increased to 9,600 lb., over 6,040 lb. of the conventional unit. The use range of the power unit is increased also by a cable capacity of 255 ft. of ⅛ in.



New Le Tourneau Power Control Unit

6x19 cable on each drum, rather than the former capacity of 186 ft. To insure quicker and more positive braking, the area of the brake has been increased over 40 per cent, and an improved braking mechanism permits the application of more pressure per square inch to the drum. A greater safety factor is thus established in operations depending on positive braking. Cooler operation is also claimed for this new model, due to the greater braking area, and to a decrease of the intra-conduction of heat because of an insulating air space between the enlarged brake drum and the clutch. The main casing has been strengthened to take more abuse without throwing strains on the enclosed working parts.

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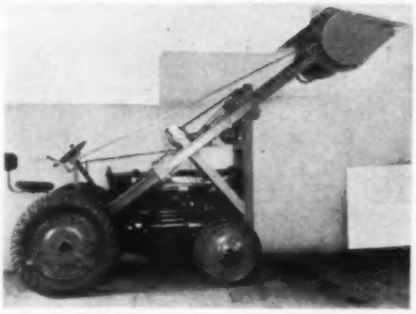
New Tractor Shovels

Four new models of mechanically operated combination shovel attachments, for Case, Farmer's Co-op, Fordson and International tractors, have been brought out by Construction Equipment Co., Elkhart, Ind. It is claimed extendable digging or loading and lifting arms, make it possible, to dig or excavate, load, transport, backfill and/or hoist with but one machine, by a simple change of attachment, without



Marvel Excavator and Loading Shovel

disturbing the main structure. The power is taken from the front end of the crankshaft by a special hub hook-up, and transmitted through a double roller chain, to the control mechanism, mounted above the engine housing, thereby giving the attachment, independent operation of the tractor movement. These new simplified attachments, it is stated, make it possible, to dig close to the tractor, and with the sliding extendable control arms moving upward to the height of the front standards (approximately 6 ft.) then outward and still farther upward, permit the shovel to be dumped in the truck, more than 3 ft. forward of the tractor, at a height of from 7 ft. 6 ins. to 8 ft. 4 ins. The standard shovel is of ½ yard capacity, controlled with a cam latch, no fingers, on an independent lever close to the driver. The clutch and brakes are operated by one lever, making them simple to handle and easy to control, and when necessary, to hold the shovel for loading or dumping at any height desired. After the first installation of the power take-off and the reinforcing plates, have been made to the tractor as permanent fixtures, there are only eight bolts to remove, block and shovel and back the tractor from under the attachment structure, time required for such operation 15 to 20 minutes, and to reinstall just drive the tractor under the attachment and tighten eight bolts, time required 10 to 15 minutes.

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Portable Power Lubrication Equipment

The Alemite division of the Stewart-Warner Corporation, 1810 Diversey Parkway, Chicago, Ill., has announced the completed development of a time-saving "portable service station," designed for power lubrication of tractors and other heavy machinery on the job. Tests on the proving grounds of one of the largest tractor manufacturers indicate that this new service equipment makes lubrication possible in approximately one-third of the time involved in the hand method. The new equipment is designed for mounting with a gasoline driven air compressor on a pick-up truck or trailer.

Portable Power Lubrication Plant

The Alemite equipment consists of pumps, hose and control valves for handling high pressure lubricant, gear lubricant and motor oil direct from original 400-lb barrels. Automatic controls maintain a normal air pressure of 150 lb. in the storage tank, cutting the compressor out when the desired pressure is attained. All connections between compressor and pumps are made with hose to eliminate danger of breakage from vibration or shifting of any of the component mechanisms.

High pressure lubricant is delivered at a pressure of approximately 30 times the pressure in the air storage tank. Both the gear lubricant and the motor oil are delivered at pressures of approximately eight times the air pressure. These low pressure pumps are capable of delivering about 14 lb. of lubricant per minute. Tests made at the tractor manufacturer's proving grounds showed that a ¼ lb. of high pressure lubricant can be injected into a bearing of track roller in 2½ seconds, about one-eighth of the time required by hand methods.

Outlets are provided for attaching an air hose to the air compressor so that tires may be kept inflated at proper pressures; so that compressed air can be used for cleaning machinery; and so that all equipment can be rapidly spray-painted on the job with the minimum loss of time.

Aware that the new portable service unit is destined for rough usage, rugged construction was specified by Alemite engineers. All pumps are sealed tightly against damage by weather or abrasive dirt, and the fact that the greases and oil are pumped from original containers eliminates the danger of contamination by grit and the inevitable losses attendant upon rehandling lubricants for hand application.

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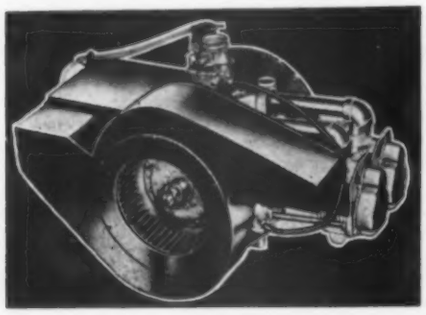
New Tire for Trailers

Following a period of engineering research which revealed emphatic proof that conventional truck type tires are inadequate to meet the demands of trailer operation, a new tire designed and built especially for trailer and semi-trailer equipment has been introduced by the Firestone Tire & Rubber Co., Akron, O. In the creation of the new Firestone FR Trailer Tire, the principal motive of the engineers has been to reduce operating cost by increasing mileage life. To obtain this objective a special tread design was developed to meet the requirements peculiar to this kind of service. The tread of the Firestone FR trailer tire is designed to fit the road. To resist side skid, the five-ribbed tread is contoured with a double radius, being flat in the center and flaring to the shoulders. Ribs and shoulders are reinforced with buttresses to provide greater stability under heavy load. The new tire is offered in five sizes to provide full coverage throughout the entire range of trailer and semi-trailer requirements.

New Light Weight Air Cooled Engine

To meet the increasing demand for an industrial engine with light weight, short length and low height characteristics, Aircooled Motors Corporation, 545 Madison Avenue, New York, N. Y., has announced a new 4-cylinder, horizontal opposed type engine with a horsepower range of from 20 hp. at 1,050 r.p.m. to 66 hp. at 3,750 r.p.m. Known as the Franklin Aircooled model CHO-150, this new engine has been designed and built under the supervision of the former engineering chiefs of the old Franklin Automobile Co. who now head the engineering staff of Aircooled Motors Corporation. The CHO-150 is adaptable to a wide range of industrial uses where light weight, short length and low height are primary requisites. The engine weighs 300 lb. net and is 36⅝ in. wide, 21⅝ in. long, and 24 in. high overall. It is adaptable to many types of portable industrial equipment such as air compressors, pumps, conveyors, hoists, loaders, welders, concrete mixers, sprayers, electric generators, refrigeratings and air conditioning units, etc. The Franklin CHO-150 engine is a further development of the 4-cylinder engine developed about a year ago for a new type, lightweight, front wheen drive automobile. However, the automobile power plant had a 3 7/16 in. stroke and a 3½ in. bore, or a displacement of 129 cu. in. In order to increase the low speed performance, the engine was enlarged to 3⅝ in. bore and 3⅝ in. stroke, or 150 cu. in. displacement. An outstanding characteristic of the engine is the direct air cooling of its cylinders. The cylinders and cylinder heads are integrally cast of special aluminum alloy. A centrifugally cast iron liner is fitted into the cylinder barrel. Each cylinder assembly is a separate unit. The crankcase is cast iron and exceptionally rigid. Lubricating oil is forced under pressure to all wearing parts, including the piston pin which floats in a bronze bushing in the rod and in bosses of the specially designed aluminum piston. Oil is also forced under pressure to all bearings of the overhead valve parts. An unusual feature of this model CHO-150 engine is the intake manifold located in the top cover of the engine. Heated oil from the crank throws is splashed up on the under side of the manifold and thus the cover acts as a heat source for the incoming charge and as an oil cooler for the engine. The engine is available with either battery or magneto ignition. When battery ignition is used the distributor is driven off the gear on the camshaft. When magneto ignition is used, it is driven off an idler gear which also drives the mechanical governor.



The Model CHO-150 Engine

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New Bulk Cement Container

A new means of batch hauling and dumping bulk cement for construction work is now provided by a cement bag offered by the Blaw-Knox Co., Pittsburgh, Pa. This bulk cement container has a capacity of eight standard bags. It is made of heavy canvas, rubberized on both sides to form a weatherproof material, and reinforced as well as multiple-sewed at points of strain or wear. The reinforced hem at the closed end is constructed for bolting to the partition board of the hauling truck. The other end is open and equipped with flap covers. After loading, the end flaps are folded and the weight of the cement pressing against the aggregates seals the bag. During transportation, the loaded bag lies on top of the sand and stone batch in the truck compartment, as shown in the illustration, and travels to the mixer in that position. Both loading and dumping are said to be made easy by the flap construction. When dumping batches into the paver skip, the flow of the aggregates releases the pressure on the folded flaps. The action of gravity then opens the cement bag automatically, and the cement flows into the skip together with the sand and stone.

Blaw-Knox Cement Bag in Rear Truck Compartment Loaded and Sealed. Note Method of Attaching Bag to Partition

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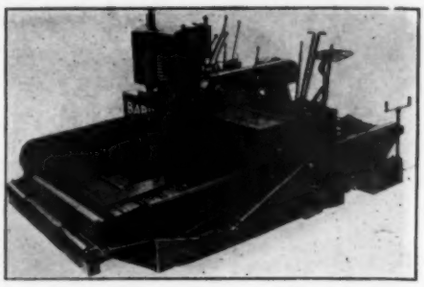
New Tamping-Leveling Machine

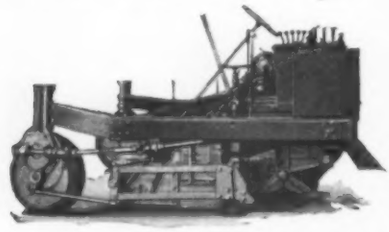
A tamping-leveling finisher just announced by Barber-Greene Co., 510 West Park Ave., Aurora, Ill., is stated to have many revolutionary features. Among the important features claimed for this machine are the following: It automatically levels without forms; it can lay to grade; it levels and compacts simultaneously; its tamping gives a permanent uniform density which greatly reduces and simplifies rolling and which will not reflect sub-grade irregularities under rolling or traffic; it makes possible very thin courses; thickness and crown are under complete control, can be changed easily while operating and are ingeniously reflected in such a manner that abrupt changes are absolutely impossible. The machine normally lays 10 ft. wide, but cutoff plates can quickly be attached for 8 ft. or extensions added for 12 ft. In laying adjacent strips, the machine is stated to do a perfect job of matching the joints. It can lay flush to the curb. The tamping of the Barber-Greene finisher is tied in with the leveling principle. In laying a smooth surface over an irregular sub-grade, the finisher necessarily lays a mat of varying thickness. Since it levels and compacts simultaneously, the machine automatically feeds the correct amount of material for the level compacted thickness. It automatically fills depressions with the extra needed material and compacts it to level. The secret of the success of the B-G leveling principle is in the delayed response of the screed to the crawlers' up or down movement over base irregularities, at the same time maintaining the required average thickness. When the crawlers respond to base irregularities over which they are riding, they simply change the direction by tilting the screed up or down rather than by actually raising or lowering a strikeoff element. Thickness, crown, and super-elevation are all easily and quickly adjusted while operating. The principle of these adjustments is tied in to the leveling principle in such a way that alterations are slowly reflected in the finished surface. Abrupt changes are impossible. Upon completion of a strip, the operators lifts the entire finisher unit by the easily operated hydraulic hoist, throws the transmission into travel speed and the machine moves along under power at high, forward or reverse travel speeds. Having maneuvered the machine into the correct position, the operator can lower the finisher unit and be ready to run almost instantly. Being crawler mounted, the finisher is extremely flexible, can turn around in its own width. For unworkable, dead, or extremely lumpy material, an agitator may be added. This consists of a toothed shaft which rotates directly in front of the tamper bar itself, keeping the material alive and tucking it underneath the tamper bar. For extremely tacky material, the screed may be heated. Barber-Greene spent several years in developing, refining and testing this machine and in 1937 accepted orders for selected jobs over the continent covering all types of work as final proof. The Barber-Greene tamping-leveling finisher is now released, and complete information will be sent without obligation to anyone writing Barber-Greene Co.



Barber-Greene Tamping-Leveling Finisher

Changes in Adnun Black Top Paver

The Foote Company, Inc., of Nunda, New York, has announced an outstanding change in their Adnun black top paver. Manual controls on screed, the power cut-off, and end gates have been replaced by hydraulic controls. The power cut-off gate at the bottom of the hopper is now divided into four sections, each section independently and hydraulically controlled by a



New Adnun Black Top Paver

small lever on the operating platform. This permits the opening of any section of the power cut-off to permit black top material to feed to the grade without opening any other section. Thus, the operator is in position to control shouldering or laying sections between car tracks, virtually while the machine is in motion.

The screed or cutter bar can be raised at either end or both ends for super-elevated curves or crowning. The end gates can be raised and lowered to feed materials to either side. Better material distribution is accomplished by removable worms to feed the material to the ends of the hopper. Hydraulic control action is smooth and easy and permits the operator of the machine to give more attention to the actual building of the road and assures better results. It also reduces day-end fatigue which often results when many levers must be handled on a machine of this character.

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New Bituminous Maintenance Unit

A new unit for applying hot or cold material under pressure either through spray bars or hand spray nozzle for maintenance of black top roads has been placed on the market by the Municipal Supply Co., South Bend, Ind. Sizes of the unit range from 400 to 600 gal. on 2-wheel trailer and from 600 to 1,200 gal. on 4-wheel trailers. All sizes are available without the trailer for mounting on truck chassis. The pump and piping system make possible: Filling the tank from tank cars or tanks; circulating the material within the tank while heating; transferring the material from one tank to another without entering the Maintenance Unit tank; discharging contents of tank through spray bar; discharging material through hand sprays; draining by gravity. The tank is elliptical, made of Grade "A" tank steel, electrically welded. Surge plates are placed on inside of tank to prevent rapid shifting of material. For 5 in. longitudinal flues located in bottom half of tank permit two-pass circulation. The two burners are of the high pressure generating type. They use gasoline or distillate. The pump is a Viking rotary, positive uniform pressure, 2 in. suction and discharge. Relief valve in head permits circulating material when valves are closed. Capacity is 53 g.p.m.. The engine is a Wisconsin Model AH, aircooled 6.7 H.P. at 1,600 r.p.m. The spray bar is 4 ft. long fitted with one set of brass slotted spray nozzles spaced on 4 6 in. centers. The hand spray attachment consists of 15 ft. of 1 in. flexible metal hose, packed on couplings with spray arm, control valve and spray nozzle.

South Bend Bituminous Maintenance Unit

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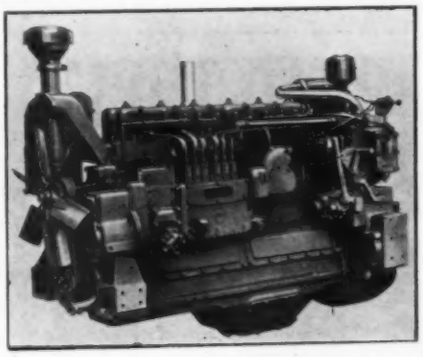
New Diesel Engine

Adding to its line of industrial Diesel engines Caterpillar Tractor Co., Peoria, Ill., has announced a new, 6-cylinder, 66 H.P. model, designed as the D4600. The new engine has a bore and stroke of 4¼ in. by 5½ in., and turns at 1400 r.p.m., normal governed speed. The engine is of the 4-stroke-cycle, valve in head, water cooled design, and features solid injection of the fuel into precombustion chambers. The fuel injection system is similar to that of all "Caterpillar" Diesels. Both the



New Caterpillar Diesel Engine

injection pumps and injection valves are set at the factory, and require no field adjustment. In construction work, the new engine will power ¾ yd. shovels and draglines. As a source of electric current, it will be offered as a unit with a 35 KW. generator at 50 cycles at 1500 r.p.m.; or as a 32½ KW. generator at 60 cycles at 1200 r.p.m. As a power unit, the D4600 engine will meet many irrigation pumping demands, and will serve as standby power for smaller municipal pumping plants, etc. It is stated that on all these jobs, at rated load of 50 H.P., the engine uses not more than 3 gal. of low cost fuel an hour. A 14 H.P., 2-cylinder gasoline starting engine is mounted at the rear of the Diesel, directly over the flywheel housing, having a governed speed of 3,000 r.p.m. This engine cranks the Diesel through a pinion and clutch arrangement which automatically disengages when the larger engine fires. The starting engine offers a positive starting method under all climatic conditions. For indoor installations, where the atmospheric temperature is more or less constant, electrical starting is available.

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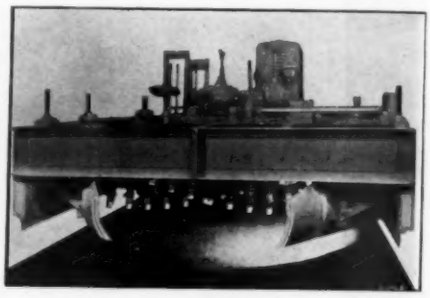
New Road Building Unit

Blaw-Knox Company, Pittsburgh, Pa., has secured the patent rights for the manufacture, distribution, and sale of two uits of road building equipment from the Flynn Manufacturing Corporation, Alex-



Blaw-Knox Road Builder

andria, La. These machines will henceforth be known as the Blaw-Knox road builder and the Blaw-Knox (Flynn) surgrader, and they will be manufacturer in the Blaw-Knox plant, Pittsburgh, Pa.

Blaw-Knox road builder is an entirely new machine and includes the latest engineering achievements in road building equipment. Some of its uses, according to the manufacturers are: Sub-grading for concrete pavement construction, and for the sub-grading required in road widening work; building shoulders along the sides of existing highways and for stabilizing secondary highways; in addition, in one operation the road builder pulverizes and mixes materials for all types of granular stabilization and for the lighter types of oil mixed work, such as emulsified asphalt. The machine travels on the sub-grade without the use of road forms. Form trenches are graded at the same time as the road bed. Transverse conveyors, which are part of the equipment, dispose of the excavated material outside the limits of the sub-graded area. Accessories adaptable to the Blaw-Knox road builder including windrowing blades; a proportioning pump for mixing water or emulsified asphalt with the material being pulverized; a tank for these mixers; and a screed with plow and blades, which may be used for smoothing the stabilized base true to crown and proper width. The road builder is also adaptable for reshaping and smoothing certain types of existing asphaltic or asphalt-macadam roads. This operation eliminates scarifying the entire pavement before re-surfacing. It may be done without disturbing the sub-grade material. The

Blaw-Knox Surgrader

machine is self propelled and is mounted on crawler type tracks. The digging and pulverizing teeth are mounted on a revolving cylinder and are adjustable for crown and cut to a maximum depth of 10 ins. Only a final blading and rolling are stated to be required after passage of the road builder.

The surgrader travels on road forms and is used exclusively for sub-grading for concrete pavement work, or other types of road construction where forms are used, and is adjustable for road widths up to 22 ft. It is stated that it can be operated successfully under all kinds of soil conditions. The machine travels under its own power on crawler treads and wheels and is so designed that its load is spread over an appreciable length of form in order to protect the form from damage and prevent settlement of forms. The unit is equipped with conveyors for removing materials from the sub-grading and carrying them into windrows alongside of road. An additional feature is a truck overpass which is entirely automatic and which allows the batch truck to drive over the machine without interrupting operations. A moving truck is also furnished for transporting the machine.

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New Heavy Duty Diesel Trucks

The Walter Motor Truck Co., 1001-19 Irving Ave., Ridgewood, Queens, L. I., N. Y., has developed the Walter ADV 150 hp. Diesel, 10 to 15 ton capacity trucks, to meet a growing demand for truck units of maximum capacity, for use with dump bodies and heavy excavation work and as tractors for log hauling or other heavy trailer service. These units embody the same four point positive drive system that is a feature of all Walter trucks. With this system, positive driving action is obtained on all four wheels, through the use of three automatic lock or torque proportioning differentials. The Diesel motor is a Cummins 6-HB 150 H.P., six cylinder. The transmission is a unique tractor type, providing six forward speeds and two reverse, with a single gear shift lever, with a high gear ratio permitting speeds of 30 miles per hour and a low gear reduction of 125 to 1, to meet all emergency operating conditions. The intermediate speeds are all closely spaced. The drive system follows the suspended double reduction drive that is characteristic of Walter construction. This chassis has a setback front axle and the cab set well forward in order to give a very short wheelbase with maximum space behind the cab for dump service. For dump service, the model ADVD 126 in. wheelbase is used, having a cab to rear axle dimension of 8 ft. For semi-trailers a shorter wheelbase, model ADVT 114 in. can be furnished. For pole trailers and log hauling a longer wheelbase of 138 in., model ADVS, is furnished. This unit is equipped with balloon tires 13:50-24 single front and dual rear. These six tires give a total tire capacity of 55,000 lb. This extra tire capacity, together with the proper weight distribution on the single front and dual rear tires, is stated to permit of carrying 15-ton payloads under all difficult operating conditions. With the short wheelbase, these models can turn in a very short space. Hydraulic steer can be furnished when required.

New Walter Heavy Duty Diesel Truck

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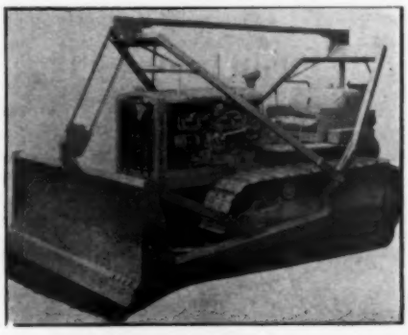
New Angledozer and Bulldozer

Built to incorporate the most practical structural features of all previous models, a new type of angledozer and bulldozer, Type C., has been added to the products of R. G. Le Tourneau, Inc., Peoria, Ill., and Stockton, Calif., manufacturers of heavy grading equipment. This new product is for use on "Caterpillar" D4, D6, and D7 tractors. Both the angledozer and bulldozer utilize a bowl and yoke structure similar to that of the current track type, but the bowl is supported by an overhead "A" frame rather than by two side arms. Due to its central mounting, this overhead frame distributes the weight of the 'dozer more uniformly over the tractor tracks—thereby reducing tractor wear to a minimum and insuring maximum traction efficiency in any material. Cable life is also lengthened because of fewer sheaves in a more simple arrangement. Operator's vision is virtually unobstructed. The angledozer embodies the quick-change angling and bowl tilting adjustments of former models—for sidecasting to right or left up to 30 degrees or for lowering either corner of the blade for ditching or side-hill cut pioneering. Both machines retain their speed, accuracy, and power of operation through a single cable from a power control unit mounted on the rear of any tractor or on the front of the D6 or D7. Special angledozers and bulldozers (not included in Type C) for the "Caterpillar" D8 tractor are similarly controlled by either the front or the rear power control unit.



New Type C Bulldozer

New Light Weight Centrifugal Pumps

The Gorman-Rupp Co., Mansfield, O., have brought out what they believe are the lightest weight self-priming centrifugal pumps with like capacities in the world. There are four different pumps in this line. The "Midget" weighs only 52 lb., but has a capacity of 5,300 g.p.h. The "Bantam," a 79 pounder, throws 7,500 g.p.h. Next in

The 52 Lb. "Midget" Held by 15-Year Old Girl

line is the "Hawk," weight 103 lb., capacity 10,000 g.p.h. The fourth is the "Eagle," weight 118 lb., capacity 15,000 g.p.h. All four are rated at a total head of 20 ft., including 5-ft. suction lift. All four are stated to be built around a revolutionary new principle that assures rapid priming on all suction lifts up to a practical 25 ft., although the guarantee covers a safe 28 ft. The new G. & R. principle of construction is claimed to assure continuous operation regardless of dirty water conditions; with the strainer on the suction end of the hose these pumps positively will not clog. They give automatic priming and are as simple in design as the larger pumps in the G. & R. line. They are powered with 4-cycle air cooled, anti-friction bearing, gasoline engines. Their automotive type high tension magneto ignition gives quick, positive starting. The Gorman-Rupp Co. has just issued illustrated literature describing this new line in detail which is available to any one requesting a copy.

▼

New Blueprint Papers

Blueprint papers of a radically new type have been announced by Kueffel & Esser Co., Adams and Third Streets, Hoboken, N. J. The improved papers are named "Series Sixty," and they are said to produce prints of an unusually deep blue color, so that the white lines of the reproductions stand out in sharp, legible contrast. This extra color strength is stated to give blueprints a high contrast ratio, and it makes them as legible as original drawings. An exceptionally wide printing range is also claimed for Series Sixty blueprint papers. Tracings of varying transparency can be printed successfully at a single setting of the machine—or strong blueprints can be made from any tracing within a broad range of machine speeds. This extra margin of printing range reduces the danger of over exposure and under exposure, eliminates the necessity for "trial prints" and greatly speeds production. Unlike ordinary blueprint papers, Series Sixty papers are light blue instead of yellow before they are exposed to light. They are handled the same as conventional papers—printed and washed with the same equipment and procedure. The advantages of Series Sixty papers are described in detail in a new 12-page booklet, containing eighteen illustrations, diagrams, and charts.

▼

New Hoist

Safety and ease of operation are emphasized in a new hoist developed by Coffing Hoist Co., Danville, Ill. Newest of the many safety features is the push button control. When the load has been elevated and it is desired to lower the hoist, the operator simply pushes in the button and the hoist's action is reversed. This control also acts as a safety stop; if the worker's hand should slip off the handle while operating, this device automatically and positively locks the handle before it can revolve or cause any damage. Two other separate safety stops prevent handle from whirling around and causing injuries to workmen. A new intermediate locking pawl works alternately and intermediately with main locking pawl and enables the load to be stopped in locking position at half the length of the regular stroke. This added pawl also serves as an extra safety. In the case of excessive overloads, hazards are definitely avoided, since the "safety valve" handle bends before any other part of the hoist will give. This serves as a warning to prevent chain from breaking or hooks from straightening out and dropping loads. The hoists are made for loads from ¾ to 15 tons, weighing from 14 to 150 lbs. Each hoist is factory tested to lift 100 per cent overload.

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New Watering Device for Parks

A new device for applying water to city park flower-beds, shrubs, trees and grass, as well as to the greens and fairways of municipal golf courses, has been placed on the market by the Hastings Canvas Co., Hastings, Neb. A hose-like watering-de-

The Soil Soaker

vice of porous canvas, open at only one end, screws to the regular hose or directly to the city hydrant. The water seeps gently through the thousands of pores in the canvas hose and rolls gently to the ground. There is no spray, therefore, no soil washing and no run-off water. In a wind, the water is not blown about—every drop goes exactly where wanted. The waterer is easily moved without shutting off the water or getting wet. The most important advantage, it is said, is the one suggested by the name—Soil Soaker. All the water soaks deeply into the soil, giving more lasting benefits than ordinary surface-sprinkling.

Soil Soaker is being built in large sizes for commercial use, as well as small sizes for home use. The manufacturer, the Hastings Canvas Co., is building under a license from the Michigan State Agricultural College.

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New Small Diameter Brake for Trailers

A new 12¼ in. by 5 in. two-shoe mechanical brake has been developed by the Shuler Axle Co., 2909 South Second St., Louisville, Ky., for use on heavy-duty, low-platform-type, slow-speed trailers for hauling heavy-duty machinery and kindred equipment using small diameter wheels when equipped with "low platform tires." This new brake is very similar in construction to the present Shuler two-shoe brake which has been used so successfully since its introduction some years ago. Shuler brake shoes are of heavy malleable iron "T" sections cast with ribbed reinforcements to provide maximum rigidity and to insure perfect arc for full drum contact, the lining being ground on the shoe after assembly to further insure this contact. Cams are of the constant rise type made of high carbon steel, heat-treated and machined to very close tolerance on the wearing surface. They are treated to a maximum hardness to insure long wear and reduce friction between the cam surface and the renewable hardened wear plates which are used on the cam end of the shoes. Eccentric anchor pins at the heel end of the shoes provide sufficient adjustment for the life of the brake lining and insure shoe centralization at all times. The molded lining, which is used on these brakes, is especially developed for heavy and continuously severe braking duty. These brakes are for use with either Shuler five stud Budd or Shuler six stud Budd hubs for use with disc type 15 in. wheels, also for use with cast wheels of the same size. While this brake has been designed for use with Shuler 10,000, 12,000, 15,000, and 16,000 lb. axles, it has also been so designed as to be adaptable to other comparable capacity axles.

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New Line of 6-Wheel Trucks

The addition of 14 new 6-wheel models to its line has been announced by the Federal Motor Truck Co., Detroit. These new models, ranging from 2 to 8-ton capacity, include both conventional and cab-over-engine types. In the new line of 6-wheelers, Federal offers a single drive for city and inter-city hauling, where roads are good and grades medium; and dual drive for operation over bad roads, snow or other conditions requiring maximum traction. The Timken rear end units on both the single and dual drive models incorporate a parallel torque rod system which maintains the vertical position of

the axles, regardless of their position relative to each other. This construction eliminates any possibility of transfer of weight from one axle to the other due to torque reaction and also prevents uneven tire wear due to unequal weight distribution. Another important feature is the full floating rear spring suspension. The ends of each spring rest on hardened steel plates which are part of the axle housings. Each spring is attached to the chassis by means of spring seats which are free to oscillate on a common, central, tubular pivot member, which is rigidly attached to the frame by two support brackets and a girder cross member. The springs ends are not subjected to any twisting force due to the rise and fall of the wheels as they follow the contour of the road surface. The springs are securely held in place on their spring seats by means of substantial spring the clamping construction of the spring seats.

▼

New "Self-Priming" Centrifugal Pumps

A new line of completely automatic "self-priming" centrifugal pumps has been brought out by The Deming Co., Salem, O. The new pumps are an addition to Deming's standard line of centrifugal pumps. One noteworthy feature claimed for the new pumps is rapid and positive priming which is accomplished without the use of tanks, built-in strainers, hand-operated controls or other mechanisms. The check valve, built into the suction, holds the prime in the pump and suction line, ready to pump as soon as the pump starts operating. The impeller is the semi-enclosed, non-clogging type, designed to pass the usual solids encountered in dewatering work. A shaft seal prevents air from entering the pump case during the priming operation and during pumping. The new pumps are available in electric motor and belt driven units as well as gasoline engine drives. Both stationary and portable units are included in the line. The electric motor and belt driven units cover a range of 16 capacities from 10 to 300 gal. per minute. The gasoline engine units are portable and especially designed for use by contractors, irrigation, well water and many similar requirements. One portable type is mounted on steel trucks with disc steel hubs and pneumatic tires. Capacities of this model range from 7,000 to 20,000 gal. per hour. Another portable unit, known as the "Light-Weight" model, is equipped with a carrying handle. Weighing only 55 lb., it can be easily carried by one man.

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Mangan Appointed Vice-President Buda Co.

R. K. Mangan has been appointed vice president of The Buda Co., Harvey, Ill., in charge of advertising, domestic and export sales of Diesel and gasoline engines sold to the automotive, general industrial, marine, stationary and oil field trade. Mr. Mangan has been associated with The Buda Company in an engineering and sales capacity for approximately 20 years.

WITH MANUFACTURERS

R. G. Le Tourneau, Inc. Promotes Burgess

Promotion of Denn M. Burgess to the position of Domestic Sales Manager from that of Eastern Sales Manager has been announced as a part of the Sales Management reorganization program of R. G. Le Tourneau, Inc., Peoria, Ill., and Stockton, Cal., manufacturers of heavy grading equipment. Mr. Burgess joined the company as Eastern Sales Manager in 1933, after having spent several years in construction contracting in the New England states. J. W. Le Tourneau, General Sales Manager since the founding of the Le Tourneau organization, now occupies the position of General Manager, an office newly created to permit his supervision and guidance over a much wider range of activity. Assisting Mr. Burgess are John R. Bryan, acting Western Sales Manager; Louis D. Le Tourneau, Central Sales Manager, and Gordon S. McKenty, Eastern Sales Manager. Mr. Le Tourneau and Mr. McKenty has been promoted from the positions of District Representative in the Pacific Northwest and in the North Central states, respectively. Succeeding Mr. Louis D. Le Tourneau as District Representative in the Pacific Northwest is Jack Le Tourneau, formerly of the service department; succeeding Mr. McKenty as District Representative in the North Central states is Howard Stilley, formerly assistant Field Engineer. Stanley D. Means continues as Federal Sales Manager.

D. M. Burgess

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W. H. Botten Dies

William H. Botten, president of the Owen Bucket Co., Cleveland, O., died March 27 at his home, 3139 Kingsley Road, Shaker Heights, O., after a month's illness. He was 73 years old. The career of this native of Cleveland encompassed a rise from the work of a tinsmith's apprentice to the executive duties of a large manufacturing concern. Mr. Botten, whose parents were early residents of the Newburgh section of Cleveland, was a graduate of Central High School. After some years in the sand and gravel business he acquired control of the Owen Bucket Co. 30 years ago. His wife, Margaret Beavis Botten, died in May, 1929. Surviving are three sons, Henry W., John B. and Edward W., all of whom are associated with the Owen company; three brothers, Dr. Harry H., Richard and Edward C., former city editor of the old Cleveland Leader, and two sisters, Mrs. Alice Stofer and Mrs. Peter Dumont.

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Reidinger Joins Bay City Shovels

Beginning in April, Mr. Arthur W. Reidinger, formerly with the McGraw-Hill Publishing Co., New York, will join the home office selling organization of Bay City Shovels, Inc., Bay City, Mich., as advertising and assistant sales manager. His previous connection for an uninterrupted period of 16 years with McGraw-Hill on the staff of Engineering News Record and Construction Methods has given him a broad background and has familiarized him with contracting and the construction machine industry.

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Atlas Conveyor to Start Foreign Sales Program

With a 6-year record of consistent gains in domestic sales, the Atlas Conveyor Co., Clintonville, Wis., on April 1 embarked on a foreign sales program. The company has engaged Charles I. Horowitz, Chicago export representative, as foreign sales manager. Formerly export manager for Hibbard, Spencer and Bartlett, prominent Chicago wholesale hardware firm, Mr. Horowitz is recognized as one of the midwest's leading export representatives. He will direct Atlas' export activities from his offices at 201 North Wells Street, Chicago, Ill.

▼

Evans Now Assistant General Sales Manager Federal

The appointment of Roy Evans as Assistant General Sales Manager of the Federal Motor Truck Company, in charge of western territory, has been announced by K. M. Schaefer, General Sales Manager. Evans has a wide background of retail and wholesale truck sales experience dating back to 1923. Most of the territory he is to handle for Federal is thoroughly familiar to him as his sales activities have centered in the middle west and southwest while serving as regional truck manager for the Chevrolet Motor Co. Before coming with Federal he was Chicago district manager for Dodge heading up truck and passenger car sales in that area.

▼

Link-Belt Atlanta Plant Enlarged

Harold L. Hoefman, general manager of the Atlanta plant of Link-Belt Co., located at 1116 Murphy Avenue, S. W., announces that this plant has in recent months been substantially enlarged in order to provide for a larger engineering department, more shipping space, and additional area for stocks of elevating, conveying and power transmitting machinery equipment.

Culverts that outlast the roads built above them

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